Research on Information Visualization Design for Suining's Intangible Cultural Heritage with Digital Intelligence

Binjie Luo[1*], Cheng Bi[2]

[1]Sichuan Normal University, Chengdu, Sichuan, China
[2]Chongqing University of Science and Technology, Shapingba, Chongqing, China

*Corresponding Author Email: anglelbj@126.com

Abstract. Within the context of digital intelligence empowerment, and drawing upon a multidisciplinary perspective, this study systematically organizes and extracts Suining's intangible cultural heritage(ICH) gene system and structured information. It constructs a four-tier decoding model encompassing "material, behavior, institutional, and conceptual". This framework informs the development of visualization translation design strategies, which are further illustrated through concrete design case studies. The study indicates that establishing a systematic methodology spanning cultural decoding to design translation facilitates the orderly organization of complex local intangible cultural heritage information and the explicit presentation of tacit knowledge. It provides theoretical support and practical reference for the preservation, transmission, and dissemination of ICH in other regions.

Keywords: Digital Intelligence, Intangible Cultural Heritage, Information Visualization Design, Translation, Decoding, Communication, Suining

1 Introduction

As an important carrier of the excellent traditional culture of the Chinese nation, the protection and inheritance of intangible cultural heritage (abbreviated as 'ICH') has been elevated to the level of national cultural strategy. In recent years, with the in-depth implementation of a series of policies such as the "Guiding Opinions on Promoting the Deep Integration of Culture and Science and Technology,"[1]the digital interpretation of intangible cultural heritage has become not only a policy priority but also an urgent practical necessity. In particular, the diverse intangible cultural heritage resources in our country are predominantly preserved through physical artifacts, images, texts, or audiovisual materials. Constrained by traditional methods of archival storage and exhibition, the inherent cultural logic of these resources remains difficult to convey intuitively[2]. Therefore, leveraging policy guidance, academic frontiers, and practical demands for intangible cultural heritage (ICH) development. Through digital intelligence

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empowerment as its entry point and information visualization design as its pivotal connector. It undertakes cultural decoding and visual translation of Suining's ICH to expand the boundaries of its dissemination, deepen public understanding of its cultural essence, and provide an analytical framework and design paradigm with practical reference value for the innovative development of local ICH.

2 The Necessity of Visualizing Information for Suining's ICH

2.1 The Intrinsic Compatibility Between Information Visualization and ICH

Information visualization design relies on visual logic language, using graphics, images, tables and concise text as carriers, and transforms abstract, complex or unstructured data and information into information graphics or symbols that are easy to understand by human beings[3]. At its core, information visualization involves systematically organizing and decoding the key information of intangible cultural heritage (ICH), transforming it into clearly structured visual graphics. This enables people to quickly grasp the informational essence and cultural significance of ICH, thereby facilitating its dissemination and sustainable development. Currently, Suining Municipality has 206 ICH items[4]. It provides abundant application scenarios and content materials for visualization design. Information visualization design offers an efficient tool for interpreting and disseminating ICH information, thereby promoting its creative transformation and innovative development in contemporary society.

2.2 The Value of Integrating ICH with Information Visualization Design

2.2.1 Opportunities and Challenges.

Currently, the protection of ICH faces opportunities such as policy support and technological dissemination, and severe challenges including the ‘difficulty of interpretation’ (making tacit knowledge explicit), communication barriers, and inheritance dilemmas. The original ‘rescue documentation’ model struggles to address the core challenges of dynamic transmission. Particularly, Suining's ICH resources exhibit diverse types, encompassing traditional dances, folk customs, and traditional crafts, which contain extensive procedural, interconnected, and spatial information. Relying solely on linear textual records would fail to fully present their dynamic logic and cultural context[5]. Information visualization design excels at organizing complex content such as processes and techniques through visual language, with a focus on the knowledge mining, extraction, decoding, dynamic dissemination, and value creation of ICH[6].The aim to visually present the spatio-temporal connections, craft processes, and interdependent relationships of ICH through information structure diagrams. Therefore, integrating ICH with contemporary presentation methods can provide a sustainable development path for enhancing cultural interpretation, expanding communication channels, and cultivating new inheritors and innovative practitioners.

2.2.2 Scene Reconstruction and Knowledge System Reorganization of ICH.

The core value of ICH lies not in its physical artifacts or procedural routines, but in the cultural systems that sustain them. Some ICH items embody substantial tacit knowledge (e.g., spiritual and cultural concepts) and dynamic processes (e.g., production techniques), making traditional textual descriptions inherently limited. However, methods of information visualization centered on spatio-temporal data or graphical and chart-based information serve to facilitate the recreation of cultural contexts and the reconstruction of critical knowledge. In particular, the vitality of intangible cultural heritage is rooted in its original cultural context. By systematically analyzing historical documents, oral traditions, and fragmented information through visual tools like timelines, flowcharts, and 2D illustrations, and other visual carriers to systematically decode and visually recreate craft processes and cultural symbols. This approach partially restores or even reconstructs the humanistic historical context, craftsmanship spirit, and cultural concepts embodied within ICH. It propels diverse ICH information toward explicit, structured presentation, achieving the visual reconstruction of knowledge systems and the efficient transmission of knowledge.

2.2.3 Deep Integration of Digital Intelligence with ICH Resources.

Digital technologies serve as a practical technical foundation for cultural storytelling and transformation design across numerous intangible cultural heritage projects[7]. In addition to using digital tools for documentation, 'digital and intelligent empowerment' emphasizes leveraging big data and artificial intelligence[8]etc. Deep mining of the value of ICH resources and processing of various information, to extract and translate key information. For example, utilizing algorithmic tools to analyze multi-source, heterogeneous intangible cultural heritage data encompassing text, images, audio, and video, uncovering hidden networks of connections among key figures and narratives within projects, and presenting these insights visually through structural diagrams, lineage charts, and other formats. Or leverage digital-intelligent technologies to integrate diverse resource formats[9], Whether in project categories such as traditional fine arts and traditional crafts, or in visual elements like form, color, and patterns, all provide content materials for visual design. Based on this foundation, creators extract and decode the cultural genes of ICH, digitizing and categorizing them with tags to build a searchable and retrievable cultural resource repository. They then select cultural gene modules and develop transformative designs to achieve the utilization and adaptation of intangible cultural heritage resources.

3 The Combing and Decoding of Suining's ICH Gene

3.1 Classification Characteristics of Suining's ICH

To fully harness and effectively utilize Suining's ICH resources, this study categorizes and systematizes local ICH projects based on official records and field research. By clarifying project tiers, developmental origins, and distinctive characteristics, it pro-

vides robust support for the creative transformation and design empowerment of Suining's ICH in the digital and intelligent era. Situated in the middle reaches of the Fu River in central Sichuan Basin, Suining historically flourished as a hub of Bashu culture and currently preserves 206 ICH items across various categories. These heritage elements, shaped by centuries of regional cultural immersion, exhibit a unique fusion of diverse influences with distinct local characteristics.

Table 1. Primary Categories and Characteristics of Suining's ICH

Classification	Item	Rank	Origin	Characteristics and Implications
Traditional Fine Arts	Clay Sculptures with Mud-Based Colors by the Xu Family	National level	Late Qing Dynasty	Made from local red clay, featuring red, green, and blue as primary colors. Involves multiple processes including composition, clay kneading, molding, and painting. Characterized by exaggerated forms.
	Bamboo weaving	Provincial level	Late Qing Dynasty	Using bamboo as raw material, the process involves key steps such as 'selection, splitting, scraping, and weaving' to craft items like door curtains, as well as works of calligraphy and painting.
Traditional Crafts	Traditional Distilled Liquor Brewing	National level	Western Han Dynasty	The process involves over a hundred steps, including raw material selection, brewing, and storage, utilizing craftsmanship such as traditional koji-making, solid-state fermentation, and clay jar storage.
	Deep Drilling for Well Salt	National level	Han Dynasty	Ancient drilling techniques, such as the 'zhuotong well' method involving bamboo-lined shafts and bamboo-tube salt extraction, represent significant inventions in early well-drilling technology.
Traditional Music	Dongjing Music	Provincial level	The Southern Song Dynasty	Renowned for its chanting of scriptures, this grand-scale performance features both vocal and instrumental categories, boasting a rich variety of melodies.
	Xiangshan Flower Drum and Gongs	Provincial level	Qing Dynasty	Performed spontaneously in fields and courtyards. Comprising both percussion and vocal elements, this humorous folk drum music blends local dialects with interwoven singing and drumming.
Folklore	Tongjiashan Daughter Monument Temple Fair	Provincial level	The Qing Dynasty's Jiaqing Period	Featuring colorful flag processions, worship ceremonies at pavilions of varying heights, and traditional folk performances such as dragon and lion dances.
	Deliver the Toad	Provincial	Qing Dynasty	'Toad' refers to frogs. The event features

		level		dragon and lion dances, a non-heritage market, and fireworks displays. Symbolizing 'warding off illness and disaster, bringing health and good fortune'.
Traditional Dance	Yangko (rural folk dance)	Provincial level	Late Tang Dynasty	The basic movements include eight types of flower stick techniques. Performers wear traditional long robes, colorful pants, ribbons, and the performance involves group participation.
	Peach Dragon	Provincial level	The reign of Emperor Wu of Han	Traditional regional festival dances, predominantly performed by female dancers, feature graceful movements such as the 'Jade Maiden Offering Peaches' gesture, symbolizing prayers for blessings and the wish for childbirth.

Combined with the "National Representative List of ICH Projects"[10]and local ICH catalog, five major categories of Suining's ICH have been identified (Table 1). Traditional art forms emphasize the beauty of visual arts, while traditional crafts highlight manual skills. Traditional music centers on sound artistry, folk customs embody the essence of social traditions, and traditional dance blends folk culture with dance aesthetics. Additionally, it includes other categories of ICH, such as traditional medicine and Quyi (folk art forms). These diverse classifications showcase the external manifestations and profound cultural significance of Suining's ICH through varied expressions. They establish a foundational framework for visual research on ICH, enabling precise identification and selection of specific ICH cases while distilling their core cultural genes.

3.2 Construction of the ICH Information Level

3.2.1 Construction Process of Information Level.

To accurately extract the core cultural information of ICH projects, it is essential to clearly define the extraction process of cultural genes and construct a visual information level. For this purpose, we introduce the five-stage design thinking model (EDIPT) proposed by Stanford University[11]. The model facilitates the extraction of key insights and complex information from ICH projects through a closed-loop process encompassing Empathise, Define, Ideate, Prototype, and Test (Figure 1). Based on this framework, we break down the information level construction of ICH into five core steps, defining objectives and target audiences, data collection, organization, and analysis, conceptual design, visual design and layout, and testing, iteration, and optimization. Through a series of steps, the entire process of collecting and organizing ICH information, constructing information levels, and transforming them into visual representations can be completed.

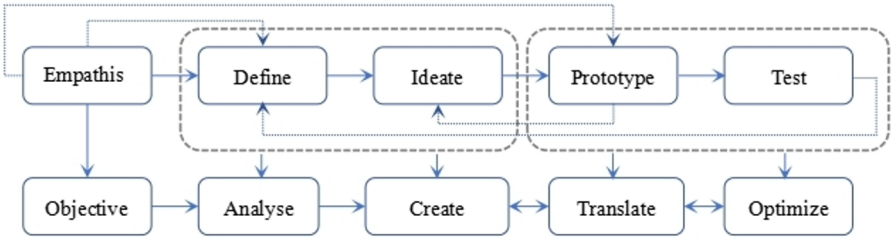

Fig. 1. Construction Process of the Information Level

3.2.2 Subdivision of Information Level.

Based on the construction process of ICH projects and the dimensional characteristics of their cultural genes, the information level are subdivided into four interlinked tiers: material, behavioral, institutional, and conceptual (Table 2). Specifically, material culture serves as the foundation, behavioral culture as the manifestation, institutional culture as the support, and conceptual culture as the core. The four tiers are mutually independent yet interdependent, forming a tightly knit logical relationship. This approach aligns with the structural principles inherent in ICH while also reflecting the trans-formative logic of information visualization from abstract to concrete and from deep to surface levels. It establishes a clear information framework for the subsequent extraction and visual translation of Suining's ICH cultural genes.

Table 2. Classification of Information Level

Information Level	Dimension	Core Concepts	Take an example
Material culture	Surface level	The tangible and perceptible physical form.	Products, tools (scissors, gongs and drums), materials, etc.
Behavioral culture	Shallow level	Actions, processes, procedures, and other dynamic sequences.	Paddle, row, dance, sing folk songs, etc.
Institutional culture	Middle level	Rules, customs, or industry regulations that govern intangible cultural heritage practices.	The 'professional training system' of traditional opera. The master-apprentice transmission system of intangible cultural heritage.
Conceptual cultural	Deep level	The spiritual essence embodied in intangible cultural heritage, including its underlying ideas, beliefs, and values.	Unity, harmony, health, happy, auspiciousness, etc.

To visually demonstrate the information level, this study uses Suining's 'Taozi Long' (Peach Dragon) ICH as a case study, categorizing the information structure into four distinct levels: theme, primary information, secondary information, and tertiary information (Table 3). The information theme, as the identity marker of the ICH project, summarizes its core information such as geographical attributes, distribution profile, and production techniques, thereby carrying the brand recognition of the ICH. The first level information is the important information, corresponding to the four cultural levels

of ICH, which constitutes the core 'skeleton' of the information architecture. Level 2 information is the subdivision and extension of the first level information. Level 3 information consists of details that cannot be further subdivided. Through informational tiering, complex information of ICH data will be deconstructed layer by layer and restructured into a systematic information framework. This approach provides a clear pathway for subsequent cultural gene extraction, driving the deep integration of ICH information from a fragmented to a systematic state.

Table 3. Information Level Classification of ICH

Topic	Title	Information level	Contents	Primary forms of expression
e.g., "Peach Dragon " of ICH	Overview	Level 1	Historical origin	Graphical description, timelines.
		Level 2	Inheritance and protection	Graphical or chart description
	Distribution	Level 1	Distribution area	Maps, Tour Guide.
	Overview	Level 2	Scope of Audience	Graphical description
	Craftsmanship	Level 1	Create Tools	Graphical description
		Level 2	Production Process	Flowcharts, and process diagrams.
		Level 3	Shape and Color	2D illustration, diagram, etc.
	Performance form	Level 1	Composition of Performers	Process diagrams
		Level 2	Combination of movements	Graphical description
	Important Performance	Level 1	Performance Theme	Icon
		Level 2	Coverage area	Graphical description

3.3 Extraction and Decoding of Cultural Genes

Based on the classification characteristics of ICH and the construction process of its information level, the four-tiered ICH information framework is established as the foundation for structured presentation. Through digital decoding of ICH cultural genes[12], extract four gene modules.

Module 1, Surface material genes refer to the tangible forms and sensory representations directly perceived. The decoding content includes: visual elements (e.g., shape, color, and decorative patterns), auditory elements (e.g., musicality, rhythm, and rhymes), and spatial elements (e.g., site layout and object morphology).

Module 2, Shallow Behavioral Genes refer to the dynamic processes, production workflows, operational logic, and behavioral pattern characteristics in the inheritance and practice of ICH. The specific decoding content covers core dimensions such as craft processes, performance routines, and ritual protocols (e.g., procedures, taboos).

Module 3, The middle-level institutional gene refers to the rules, norms, and order followed in the operation of ICH projects, aiming to ensure the stability and standardized development of ICH transmission. Its decoding content includes time (e.g., Spring

Festival), location, costume coordination systems, core rituals, and fixed elements (e.g., dragon dance, gong and drum performances).

Module 4, The deep spiritual genes embedded in ICH projects encompass value concepts, philosophical thoughts, aesthetic orientations, regional spirit, and cultural metaphors. The decoding dimensions include: functional values (practicality, education, entertainment), aesthetic concepts (e.g., the pursuit of harmony and auspiciousness), ethical concepts (e.g., ecological awareness of reverence for nature), and auspicious cultural connotations.

Therefore, constructing a multi-level decoding model for Suining's ICH based on cultural gene theory facilitates systematic analysis across dimensions, from superficial forms and shallow-level behaviors to institutional frameworks and profound spiritual dimensions. For instance, this approach involves decoding performers' physical postures, costume patterns, and color schemes of the “Peach Dragon” performance. Deconstructing the craftsmanship of peach-making and the composition of performance troupes to identify core dance sequences. Analyzing the regulatory rules governing performances during special festivals like Spring Festival and Lantern Festival of China. And exploring the auspicious cultural core of ‘praying for blessings and fertility’ embedded in the heritage. These efforts enable precise identification of the cultural essence of Suining's ICH.

4 Design Practice of Suining's ICH Visual Translation

4.1 Strategies for Translation Design

4.1.1 Principles of Translation Design.

To ensure the accuracy and effective implementation of cultural translation, design practices need to adhere to the following core principles.

First, adhere to the principle of fidelity. Visual translation should be grounded in the decoded cultural core, avoiding deviation or distortion of original cultural information due to excessive pursuit of formal aesthetics. Accordingly, material genes should be precisely aligned, behavioral genes should be logically coherent, institutional genes should be rigorously standardized, and spiritual genes require apt metaphors.

Second, adhere to the principle of narrative structure. Organize fragmented cultural gene information by embedding it within specific interactive environments or logical narrative frameworks to enhance the storytelling quality and immersive experience of information delivery.

Third, adhere to the principle of tiered structure. To highlight the distinctive features of the design, establish a clear visual level. It can be achieved through the four-level structure of cultural genes. The material gene level, typically presented through intuitive 2D/3D graphics or breakdown diagrams. The behavioral gene level, suitable for flowcharts, timelines, and interactive graphics. The institutional gene level, which employs structural diagrams, mind maps, and logical relationship diagrams to illustrate institutional requirements and responsibility allocation. The spiritual gene level, which utilizes metaphorical graphics and contextual illustrations to ensure visual richness and logical coherence.

Overall, design principles establish the logical framework for visual translation, constraining and guiding the selection and application of specific methods to ensure the accurate transmission of ICH's cultural genes through appropriate and effective visual language.

4.1.2 Methods of Translation Design.

To successfully achieve the visual translation design of ICH information, it is necessary to adhere to the four-tier structural characteristics of its cultural genes. By leveraging the enabling advantages of digital and intelligent technologies and following the cultural gene extraction and decoding process elaborated in the preceding chapter, a progressive visualization transformation of "form, behavior, system, and spirit" can be realized. Aiming to achieve the visual translation of cultural genes through an information structure comprising "cultural symbols, digital decoding, and spiritual transmission".

To demonstrate this method, we take the traditional folk dance "Peach Dragon" in Chuanshan District, Suining Municipality, Sichuan Province as an example. This folk dance, named for its peach-shaped dragon body and also known as the "Disconnected Dragon", was included in the first batch of Sichuan Province's provincial-level intangible cultural heritage list in 2007. Through online and offline research on the ICH of "Peach Dragon", then utilizing AI tools to collect and organize textual materials, extracting valuable visual and textual information. Subsequently, using AI tools such as Midjourney, Jimeng, and Zhipu Qingyan, static graphics of intangible cultural heritage projects were transformed into flat-style two-dimensional illustrations. These recreated performance scenes from special festivals and related activities, bringing the cultural essence of intangible heritage to life within the digital space.

4.2 Design of Case Studies

The ICH project "Peach Dragon" carries profound cultural significance and distinctive regional characteristics. However, constrained by traditional inheritance models, its influence struggles to transcend geographical boundaries. Currently, its dissemination primarily relies on offline performances, and existing exhibition and communication channels often confine this heritage within local cultural spaces. To this end, the project focuses on the digital visualization of Suining's ICH, extracting, decoding, and translating the "Peach Dragon" ICH information to preserve and promote traditional folk culture. The work centers on the theme 'Peach Melody Inheriting Dragon', with the character 'Cheng' (inheritance)highlighting the core of ICH transmission, while 'Xiang' encapsulates the auspicious meanings its various elements embody. The creative process explores dimensions including its overall profile, developmental trajectory, historical origins, auspicious symbolism, craftsmanship, performance props, performance formats, major exhibitions, and preservation efforts. Utilizing AI tools to decode cultural genetic information, the project transforms the surface-level forms of the "Peach Dragon" intangible cultural heritage. Such as the dragon's dynamic, curved silhouette, shallow behaviors (performance conventions like 'dragon procession' and

'peach play' with their distinctive exhibition settings), mid-level institutional culture (production standards for longevity peaches), and deep spiritual essence into an intuitive visual symbol system.

Fig. 2. Information Visualization Design for Suining's 'Peach Melody Inheriting Dragon'

This information visualization design practice employs modern technology and expressive techniques to present its cultural essence through integrated text and imagery. The composition adopts a central layout, with the 'S-shaped dragon' graphic at its core, surrounding key intangible cultural heritage information in an enveloping arrangement. The color palette features a warm-cool combination dominated by pale yellow and light brown tones (Figure 2). The resulting visualization work employs concrete visual expression to intuitively convey the core cultural information of the "Peach Dragon". It aims to broaden the channels for showcasing intangible cultural heritage and lay a foundation for people to quickly grasp its cultural significance.

This case study advances traditional intangible cultural heritage from 'textual documentation' to 'vivid visual expression' through precise decoding and visual representation of the "Peach Dragon" cultural DNA, establishing a practical paradigm for translating other intangible cultural heritage projects in Suining. The design follows four core practical pathways: thematic refinement and anchoring cultural essence, cultural information deconstruction, narrative design (logical structuring), and visual strategy. Ultimately, it achieves the inheritance goal of making intangible cultural heritage appreciable, understandable, and disseminable through digital intelligence empowerment, injecting new momentum into the modern dissemination and living transmission of Suining's ICH resources.

5 Conclusion

In the digital and intelligent information era, information visualization design methods can facilitate the innovative integration of ICH. This approach enables the 'Dynamic' essence of ICH to permeate the cognitive dimensions and practical domains of younger generations, driving a transformative leap from preserving the past to creating the future. Although research has made phased progress, future efforts should leverage the innovative 'digital intelligence + ICH + experiential' model. By incorporating emerging technologies like augmented reality (AR) and virtual reality (VR), we can enrich the dynamic presentation forms and interactive dimensions of ICH visualization design. This will create immersive cultural experience scenarios and expand the dynamic dissemination channels of ICH. Therefore, the deep integration of ICH elements with information visualization design will significantly advance the innovative development and living inheritance of ICH in contemporary society.

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