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# REVITALIZING INTANGIBLE CULTURAL HERITAGE IN THE GRAND CANAL'S ANHUI SECTION: PATHWAYS AND DIGITAL STRATEGIES

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**Abstract:** The Anhui section of the Grand Canal is rich in intangible cultural heritage (ICH). However, the tacit and fragmented nature of these resources makes it difficult to present their cultural meanings comprehensively. Building on an examination of the forms of ICH-related knowledge and the current state of digital development in the region, this paper explores the mechanisms through which artificial intelligence (AI) can facilitate the revitalization of ICH and proposes pathways for digital preservation. The study argues that the structural challenges facing digital preservation in the region arise from the combined effects of four factors, which include intelligent recognition, knowledge reconstruction, collaborative innovation, and value conversion, rather than from a mere lack of technology. The central task of digital preservation is to shift its focus from documentation and display toward knowledge reconstruction and intelligent services, thereby making digital technologies a form of infrastructure underpinning the systematic safeguarding and living transmission of ICH.
**Keywords:** Grand Canal's Anhui Section; Revitalization of intangible cultural heritage; Digital strategies

## 1 INTRODUCTION

The Anhui section of the Grand Canal passes through the cities of Huaibei and Suzhou. According to available statistics, ten ICH items along this section have been designated at the national level [1], yet they differ considerably in their forms of knowledge and patterns of transmission. For example, Dangshan suona (a Chinese oboe) has a complete four-tier succession system and a practitioner community of more than 2,000 people [2]. A classic work of Sizhou Opera has been included in a national audiovisual preservation program [3]. By contrast, the “huāqiāng” (florid vocal style) of Yugu Daoqing (a traditional Chinese narrative singing genre accompanied by the yugu drum and clappers) is now performed by only one surviving inheritor [4], while Yongqiao circus faces pressure to transform its practices in response to changes in animal-protection policies [5]. The sharply divergent trajectories of these practices within the same region provide a particularly revealing setting in which to examine when and why digital preservation succeeds or fails.

Existing studies tend to approach the digitalization of ICH as a problem of technology application, focusing on acquisition equipment, storage formats, and modes of display [6-7]. Much less attention has been paid to a more fundamental question: can the outputs of digitalization be transformed into knowledge resources that are genuinely useful for ICH safeguarding and transmission? For instance, the transmission of Dangshan suona depends on orally transmitted melodic modes and techniques such as "kaxi" and "menqiang" [8], which cannot be fully conveyed through static audio recordings. Audiovisual recordings of Sizhou Opera preserve stage performances, but its vocal patterns and performance conventions have not been structurally annotated in a searchable format. The endangered status of Yugu Daoqing makes emergency documentation particularly urgent, yet no systematic digital archive specifically devoted to this practice has been identified in publicly available information. Likewise, no digital knowledge-organization practices have been reported for the animal-training expertise and performance conventions of Yongqiao circus. The common issue is therefore not simply whether digitalization has taken place, but whether the resulting digital materials are usable as knowledge. Taking these four nationally designated ICH items as representative cases, this paper examines the current foundations for, and principal obstacles to, the revitalization of ICH in the Anhui section of the Grand Canal. It then analyzes the mechanisms through which AI can provide support and proposes practical pathways for effective digital preservation.

## 2 FOUNDATIONS AND CHALLENGES OF ICH REVITALIZATION IN THE GRAND CANAL'S ANHUI SECTION

### 2.1 Current Foundations for Revitalizing ICH in the Grand Canal's Anhui Section

#### *2.1.1 Cultural foundation for ICH revitalization*

The areas associated with the Grand Canal's Anhui section, including Huaibei and Suzhou, possess rich resources in traditional theatre, folk arts, folk customs, and traditional craftsmanship [9]. ICH items, for example, include Huagu

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Opera, Southern-style Linhuan suona, Sizhou Opera, Huaibei dagu (large drum performance), Huaibei clay sculpture, the processing techniques for Linhuan baogua, and Linhuan tea-drinking customs. The ICH list published by Suzhou includes Sizhou Opera, Sizhou paper-cutting, traditional Sizhou musical-instrument making, the Sizhou Dragon Boat Race, Suzhou embroidery, and the art of performing with Lingbi chime stones. The cultural value of these resources lies not only in the techniques or customs themselves, but also in their connections with local social life, historical spaces, and regional cultural exchange [10]. Given the differences among ICH items at various designation levels, this paper focuses exclusively on nationally designated items. At present, nine representative national-level ICH items are associated with the Grand Canal's Anhui section, spanning four categories: traditional theatre, traditional music, folk arts, and traditional sports, games, and acrobatics [1]. The four cases selected here—Dangshan suona, Sizhou Opera, Yugu Daoqing, and Yongqiao circus—belong respectively to traditional music, traditional theatre, folk arts, and traditional sports, games, and acrobatics. As shown in Table 1, Sizhou Opera has a clearly documented record of high-standard audiovisual preservation. Huagu Opera has been the subject of academic research, but a systematic archive has not been established. No targeted digital-development initiatives have been publicly reported for the other items; they appear only as basic text-and-image entries in the Suzhou municipal ICH database, which contains relatively little audio, video, or three-dimensional model data.

**Table 1** Categories, Knowledge Forms, and Digital Development of National-Level ICH Items in the Grand Canal's Anhui Section

| ICH Category | ICH Item | Knowledge Forms | Digital Development |
|---|---|---|---|
| Traditional music | Dangshan Suona | Instrumental performance practice centered on orally transmitted melodic modes and playing techniques | No publicly accessible systematic digital records; basic text-and-image entries are available in the municipal database |
| | Lingbi Bolin Laba | A family-transmitted suona performance tradition melodic modes and playing techniques are equally important | There is a digital publishing project titled Vital Sound, which comprises 71 tracks. However, the municipal database still contains only basic textual entries. [11] |
| Traditional theatre | Sizhou Opera | Embodied performance conventions and a vocal system relying on inheritors' bodily memory | The classic work "Fan Lihua Appeals in Court" was recorded for the China Traditional Opera Audiovisual Project and permanently preserved in high-definition format; however, the record covers only one work, and the vocal system and performance conventions have not been structurally annotated [3] |
| | Huagu Opera | Embodied performance conventions (gestures, vocal patterns, and stage movement) that rely heavily on situational judgment | Fragmented short-video-based teaching research is available [12], but a systematic digital archive and database of performance movements have yet to be established |
| | Bangzi Opera | Embodied performance conventions and the Bangzi vocal system | No publicly accessible systematic digital records; basic text-and-image entries are available in the municipal database |
| | Zhui Opera | A form of traditional theatre accompanied by the zhuihu fiddle, emphasizing both vocal patterns and performance conventions | No publicly accessible systematic digital records; basic text-and-image entries are available in the municipal database |
| | Dangshan Sipingdiao | Local operatic vocal styles and performance conventions | No publicly accessible systematic digital records; basic text-and-image entries are available in the municipal database |
| Folk arts | Yugu Daoqing | A form of storytelling and singing accompanied by a fish-drum and clappers, with vocal styles classified as hanqiang and huāqiāng | No publicly accessible systematic digital records; basic text-and-image entries are available in the municipal database |
| Traditional sports, games, and acrobatics | Yongqiao circus | Embodied skills involving animal training and acrobatic performance, including animal-training expertise and performance conventions | No publicly accessible systematic digital records; basic text-and-image entries are available in the municipal database |

### *2.1.2 Policy and platform support for ICH revitalization*

The Outline of the Plan for the Protection, Inheritance, and Utilization of Grand Canal Culture, issued by the General Office of the State Council of China, calls for the integrated protection of cultural heritage and the integration of culture and tourism [13]. The Opinions on Promoting the Implementation of the National Cultural Digitalization Strategy sets out measures concerning the digitalization of cultural resources and the development of data systems [14]. At the provincial level, Anhui's digital ICH museum operates on a regular basis and continues to advance data governance. In 2025, a system integration and migration project was launched to upgrade the digital museum and review existing data [15-16]. Anhui has also held five consecutive editions of the Grand Canal Cultural Belt ICH Exhibition and announced ten nationally designated representative ICH items and ten national-level representative inheritors [17].

### *2.1.3 AI technologies for ICH revitalization*

Advances in AI have introduced new technological means for documenting, organizing, and disseminating ICH. First, multimodal recognition technologies can assist in processing images, audio, video, and textual materials, thereby improving the efficiency of ICH archive management. Second, natural language processing and knowledge-graph technologies can establish links among ICH items, inheritors, historical documents, technical processes, and geographical spaces, helping to address the fragmentation of traditional archives. Third, generative AI can assist in producing digital narratives, cultural introductions, teaching materials, and creative design proposals. Intelligent interactive technologies can also provide more targeted services for cultural venues, educational study tours, and culture-and-tourism guidance [18-19].

### 2.2 Key Challenges in Revitalizing ICH in the Grand Canal's Anhui Section

#### *2.2.1 Gaps in resource digitization infrastructure and system integration*

The revitalization of ICH depends first and foremost on basic materials that are complete, accurate, and regularly updated. Anhui Province has established province-wide digital infrastructure for ICH—the Anhui Intangible Cultural Heritage Website [15]. This platform provides a basic mechanism for aggregating data on ICH items associated with the Anhui section of the Grand Canal. However, its data collection remains incomplete; search and browsing functions are still organized primarily by catalogue category; and it lacks a dedicated portal for the "Anhui section of the Grand Canal" or "ICH associated with Grand Canal culture." At present, textual archives, images, audio and video materials, inheritor profiles, and historical documents relating to ICH items may be dispersed among cultural authorities, public cultural institutions, research organizations, and individual inheritors. Differences in data formats, classification standards, and management practices make cross-platform linkage and integrated use difficult.

#### *2.2.2 Weak knowledge linkages and limited intelligent interpretation capacity*

ICH are not isolated items; rather, they form a cultural system composed of historical contexts, bearers of transmission, technical processes, local knowledge, and social functions. Existing digital archives are generally organized around individual items and therefore fail to reveal adequately the cultural connections among different practices. Traditional craftsmanship also contains substantial tacit knowledge accumulated through experience, including material selection, applied force, movement rhythm, and situational judgment [20]. Such knowledge cannot be fully represented through text or static images, nor can AI derive an accurate understanding of it automatically through statistical learning from limited materials. Without a reliable knowledge base and expert review, intelligent systems may conflate cultural traditions from different regions and generate inaccurate historical interpretations.

#### *2.2.3 Insufficient integration of technology and dynamic ICH inheritance*

The core value of ICH lies not only in the documentation of cultural forms, but also in their continued reproduction through inheritors, communities, and social practices [21]. Digital displays can help the public learn about a particular craft or art form, but they cannot fully replace master-apprentice instruction, live demonstration, and long-term practice. If technological development is carried out mainly by external organizations, with inheritors serving merely as providers of source materials, technological applications may become disconnected from the actual needs of transmission. Inheritors should therefore be involved throughout the processes of material organization, knowledge verification, technology application, and outcome evaluation, shifting technology-enabled work from one-way data collection toward human–AI collaboration.

#### *2.2.4 Weak value conversion of digital outputs*

AI can improve the efficiency of cultural-content production and dissemination. However, whether digital content can be converted into high-quality educational services, cultural and creative products, and culture-and-tourism experiences still depends on the quality of the cultural content, public demand, and the capacity for sustained operation [22]. Take Dangshan suona as an example. If its melodic-mode system and techniques such as "kaxi" and "menqiang" have not been annotated as knowledge, generative tools may be able to produce promotional copy or short-video scripts in large quantities, but they cannot ensure the accuracy of technical descriptions. The resulting products may remain superficial collages that merely incorporate suona-related imagery, rather than conveying cultural content that can be taught or experienced. Similarly, the animal-training expertise and performance conventions of Yongqiao circus must first be organized as knowledge before they can support the design of culture-and-tourism experiences, rather than serving merely as atmospheric elements intended to attract visitors.

#### *2.2.5 Inadequate safeguarding of cultural rights and interests*

The mechanisms governing data authorization, intellectual property, and the protection of cultural rights relating to ICH along the Grand Canal's Anhui Section remain underdeveloped. This is reflected in the combined effects of missing dedicated rules and an imbalance in practical priorities. Although relevant policies call for stronger intellectual-property protection, they largely focus on the stages of data collection and documentation and do not specify the boundaries governing subsequent uses of the collected materials. This creates a situation in which "collection has a basis, but authorization lacks rules." In practice, the status of ICH inheritors as rights-holders has likewise not been institutionally confirmed. For example, no clear contractual arrangements have been established in existing digitalization practices concerning the performers' rights of Sizhou Opera inheritors or the right of the sole remaining inheritor of Yugu Daoqing to give informed consent regarding the scope of use of their vocal performances.

## 3 MECHANISMS OF AI-EMPOWERED ICH RESOURCE REVITALIZATION IN THE GRAND CANAL'S ANHUI SECTION

AI-enabled ICH revitalization is not simply a matter of embedding a single technological tool. Rather, it is a systemic process involving the sustained coupling of data, knowledge, stakeholders, application scenarios, and institutions. In light of the characteristics of ICH associated with the Anhui section of the Grand Canal, this paper identifies four interconnected stages: intelligent recognition, knowledge reconstruction, collaborative innovation, and value conversion. Together, these stages help move ICH from being merely recordable to becoming understandable, transmissible, and usable, while establishing cultural and rights-based boundaries for technological application (see Figure 1).

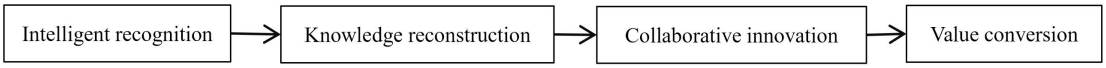



**Figure 1** Mechanisms through Which AI Facilitates the Revitalization of ICH in the Grand Canal's Anhui Section

### 3.1 Intelligent Recognition

Differentiated data-acquisition approaches should be adopted for ICH items with different forms of knowledge. For Dangshan suona, audio analysis can help identify differences in melodic styles among performing ensembles, while speech transcription can document inheritors' oral explanations of the key techniques involved in "kaxi." For Sizhou Opera, video analysis can extract key movement points in performance conventions for subsequent annotation. Given the endangered status of Yugu Daoqing, the priority for intelligent recognition should be to assist in high-fidelity audio recording and lyric transcription, thereby creating an analyzable data foundation for the "huāqiāng" vocal style. For Yongqiao circus, multi-angle video recording can capture the timing and rhythm of human–animal coordination. However, technological outputs must be verified by inheritors; the authority to make judgments based on animal-training experience must not be delegated to algorithms.

### 3.2 Knowledge Reconstruction

AI technologies facilitate the transformation of scattered materials into an interconnected knowledge system. Although the four practices belong to different categories, they may have historical connections within the broader cultural context of the Grand Canal. Whether traces of musical exchange along the Canal remain in the melodic system of Dangshan suona, and how the origins of Yongqiao circus relate to commercial activities along the Canal, are questions that require the linked organization of ICH records, local gazetteers, historical documents, and oral accounts. Knowledge-graph technologies can help establish an associative network linking "ICH item—inheritor—technical element—historical document—cultural space," enabling researchers and the public to retrieve and compare information about different practices through the cultural narratives of the Canal. For Yugu Daoqing, knowledge reconstruction also has an urgent safeguarding function: structuring records of the sole surviving inheritor's vocal techniques, repertoire, and performance contexts can at least provide a data-based medium through which knowledge of the "huāqiāng" style may be transmitted.

### 3.3 Collaborative Innovation

AI broadens the contemporary modes of expression for ICH culture. Different dissemination needs call for differentiated approaches. Dangshan suona is already disseminated through multiple channels, including performances at the Pear Blossom Festival, arts-school teaching, and school-based courses [23]. With appropriate authorization, materials relating to Sizhou Opera could be used to generate opera-learning resources for young audiences. Dissemination of Yugu Daoqing should prioritize emergency documentation rather than mass-oriented content production. As Yongqiao circus involves animal performances, the boundaries of generated content must comply with relevant social norms concerning animal welfare. At this stage, AI should assist cultural expression rather than replace cultural judgment.

### 3.4 Value Conversion

This primarily refers to scenario-based applications built on knowledge outcomes. For example, Sizhou Opera could be incorporated into study-tour courses on traditional theatre, provided that its vocal patterns and performance conventions have first been annotated in a teachable format. Applications involving Yugu Daoqing should initially serve inheritor training and community dissemination rather than commercial development. The integration of Yongqiao Circus into culture-and-tourism activities must proceed prudently within the framework of animal-protection policies. The common principle governing value conversion is that applications should be grounded in the results of knowledge organization, with inheritors' judgments serving as the baseline for quality assurance.

## 4 PATHWAYS TO AI-EMPOWERED REVITALIZATION AND DIGITAL DEVELOPMENT OF ICH RESOURCES IN THE GRAND CANAL'S ANHUI SECTION

### 4.1 Strengthening Resource Surveys and Digital Archiving

Accurate identification and standardized documentation of ICH are prerequisites for AI-enabled revitalization. A thematic survey of resources associated with the Grand Canal's Anhui section should be conducted on the basis of existing ICH lists, local gazetteers, historical documents, and survey findings, with data collected by category of ICH item. For traditional theatre, priority should be given to collecting repertoires, vocal patterns, movements, and oral accounts. For folk customs, records should focus on activity settings and local memories. For traditional craftsmanship, materials, tools, procedures, and transmission-related experience should be documented. For example, the item profile on the China Intangible Cultural Heritage Website notes that Sizhou Opera was formerly known as "Lahunqiang," is popular along both banks of the Huai River in Anhui, and has undergone a lengthy historical development [24]. Digitally organizing this practice requires more than recording its repertoire and performance videos; its vocal patterns, evolution as an opera genre, inheritors, historical documents, and regional dissemination should also be linked.

### 4.2 Enhancing Cultural Linkages and Intelligent Interpretation Capabilities

Following the organization of basic resources, ICH materials should be transformed from dispersed archives into a structured knowledge system. First, a multilayered knowledge graph should be developed, using ICH items as the core nodes and linking them to inheritors, technical processes, historical documents, cultural spaces, and related folk customs. Thematic knowledge units could be established for practices such as Sizhou Opera and Dangshan suona. Second, a knowledge-verification mechanism involving both specialists and inheritors should be established. Inheritors should verify technical processes and local terminology; researchers should examine documentary evidence and cultural connections; cultural institutions should review data sources and safeguarding requirements; and technical personnel should maintain the system. Where historical interpretations remain contested, multiple evidence-based accounts should be retained rather than allowing algorithmic standardization to erase cultural differences.

### 4.3 Strengthening Human–AI Collaboration in Living Transmission

The fundamental purpose of applying AI to ICH is to support its continued transmission in contemporary society, not to use technological simulation as a substitute for authentic cultural practice. Inheritors should be supported in participating in the organization of digital materials and the development of content. They should be invited to annotate technical steps, explain key movements, interpret local terminology, and review generated content, thereby shifting their role from mere providers of source materials to active co-creators of digital resources. Digital documentation of Yongqiao circus can preserve video materials showing representative performance routines and animal-training processes, providing basic resources for skills instruction and industry archives. However, the accumulation of animal-training expertise, judgments about the timing of human–animal coordination, and on-site adjustments to program arrangements still depend on long-term training and actual performances. AI can therefore assist documentation and learning, but it cannot replace the experiential judgment of those responsible for transmission.

### 4.4 Integrating AI with ICH Cultural and Creative Products

Generative AI can assist cultural-content creation and product design, but such applications must be based on reliable cultural knowledge, clearly defined permissions, and appropriate review mechanisms. First, digital narrative products featuring Grand Canal culture should be developed. Verified historical materials and relevant ICH items can provide the basis for digital stories, interactive narratives, online exhibitions, and multimedia content. Second, the integration of ICH elements into digital cultural and creative design should be explored. Under the guidance of inheritors, traditional forms and craft characteristics can be identified, and authorized visual elements from traditional opera can be incorporated into educational materials and digital communication designs.

### 4.5 Improving Safeguarding Mechanisms for Cultural Rights and Interests

Once inheritors' oral accounts, images of technical practices, and related knowledge have been collected, their subsequent use for model training or commercial product development requires clearly defined scopes of use and authorization conditions. This issue should be addressed in conjunction with applicable laws and regulations, with particular attention to distinguishing among different purposes, including archival preservation, public dissemination, model training, and commercial development. For example, a video documenting the production process of a traditional craft may be used for ICH archival preservation; this does not mean that the same video may be used for commercial advertising or generative-AI training without further authorization. The views of relevant communities should be respected even more carefully when traditional knowledge is governed by community norms or is unsuitable for public disclosure [25]. A full-process governance mechanism is therefore needed, covering data collection, storage, authorization, model use, publication of outputs, and benefit sharing.

## 5 CONCLUSION

This research indicates that AI provides new technological conditions for documenting, organizing, disseminating, and innovatively utilizing ICH associated with the Anhui section of the Grand Canal. Its significance extends beyond improving information-processing efficiency to fostering connections among bodies of cultural knowledge, innovating

modes of transmission, and expanding application scenarios. Using Dangshan suona, Sizhou Opera, Yugu Daoqing, and Yongqiao circus as four nationally designated ICH cases throughout the analysis, this paper demonstrates that AI-enabled ICH revitalization is a systemic process shaped by the interaction of technological capabilities, cultural resources, transmission stakeholders, application scenarios, and institutional rules. The central thrust of the proposed pathway is to shift the logic of digitalization from "documentation and display" toward “knowledge organization and intelligent services.” For the Anhui section of the Grand Canal, this means that in future, digital technologies should no longer serve merely as tools for preserving ICH; they should become infrastructure supporting its systematic safeguarding and living transmission. ICH inheritors should participate substantively throughout the digitalization process, while institutional arrangements should provide a predictable framework for data collection, use, and benefit sharing. Only in this way can technological empowerment become embedded in the social processes through which ICH is continuously transmitted, rather than remaining detached from cultural practice.

## COMPETING INTERESTS

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