

## 2025 International Conference on Fiscal Management, Holistic Social Studies (FMHSS 2025)

Article

# Research on the Digital Presentation and Inheritance of Macao's Portuguese-Style Cultural Experience from the Perspective of Multimodal Generative Narration

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**Abstract:** As a city with a unique historical background, Macao, China, possesses a Portuguese-style culture that is the result of a long-term blend of Chinese and Western traditions, representing an irreplaceable cultural value. This unique product of over four centuries of interactive symbiosis constitutes a core sample of cultural diversity within the Guangdong-Hong Kong, China-Macao, China Greater Bay Area. Currently, the preservation of this heritage faces significant challenges, including an aging inheritance system and the simplification of communication forms. To address these issues, this paper discusses the digital presentation and inheritance of the Portuguese-style cultural experience in Macao, China, from the perspective of multimodal generative narrative. First, the study examines multimodal generative narrative theory alongside the rich connotations of this regional culture. Next, it introduces the current situation of digital cultural presentation, analyzing the explorations and challenges of multimodal applications. By employing literature research, case analysis, and field research, this study puts forward an innovative application strategy for multimodal generative narratives in this field. Drawing inspiration from successful domestic and international digitalization cases, the research explores the profound influence of these technologies on cultural preservation. Ultimately, this study expands the application boundaries of multimodal narrative theory, builds a comprehensive evaluation system for digital inheritance, and provides a methodological reference for the dynamic transmission of cross-regional cultural heritage, offering vital theoretical and practical references for the digital development of related cultural fields.

**Keywords:** multimodal narrative; digital presentation; cultural heritage; virtual reality; artificial intelligence

Received: 28 April 2026

Revised: 11 June 2026

Accepted: 26 June 2026

Published: 01 July 2026



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The concept of multimodal generative narratives, when examined in the context of Portuguese cultural influences in Macau, China, offers a unique perspective on the interplay between historical heritage and contemporary creative methodologies [1]. This approach highlights the integration of diverse cultural elements within a dynamic narrative framework [2].

### 1. Analysis of Multimodal Generative Narrative Theory

Multimodal narration integrates various elements such as text, images, audio, and video, which work together to create a cohesive narrative system. Text serves as the foundation, providing essential information and a logical framework, while images enhance the narrative's intuitive and expressive power. Audio contributes by establishing specific atmospheres, and video enriches the sensory experience through the dynamic interplay of visuals and sound. Generative narrative, as an innovative approach in the era of artificial intelligence, leverages technologies like AI and machine learning to analyze

and learn from extensive datasets. This enables the automatic generation of narrative content and real-time adjustments based on user interactions, offering a personalized and interactive experience. Unlike traditional static narratives, generative narratives are characterized by dynamic adaptability. User behavior data is processed using natural language processing technology, and new content that aligns with narrative logic is generated in real time through advanced algorithms such as generative adversarial networks. This approach facilitates a diverse and personalized narrative experience. In the context of cultural preservation and dissemination, this technological innovation provides several advantages [3, 4]. Firstly, it addresses the challenge of producing large volumes of cultural content by generating numerous derivative narratives through algorithmic processes. Secondly, it allows for the creation of branching narrative paths, enabling users to explore different storylines based on their preferences. Thirdly, it supports multi-dimensional cultural interpretation by presenting the same cultural element in varied ways through different combinations of modalities, thereby enriching the interpretative possibilities.

In cultural applications, multimodal generative narratives offer significant advantages by creating immersive experiences that make users feel as though they are part of the scene. This immersive quality enhances user engagement and fosters a deeper understanding and appreciation of cultural elements [5]. The interactive nature of these narratives further increases user participation, allowing individuals to actively engage with the content rather than passively consuming it. Additionally, the ability to customize these narratives ensures that they can cater to the diverse needs and preferences of different users, providing tailored cultural experiences. This adaptability not only broadens the appeal of cultural narratives but also ensures that they remain relevant and accessible to a wide audience. By leveraging advanced technologies, multimodal generative narratives can bridge the gap between traditional cultural expressions and modern technological advancements, creating a dynamic platform for cultural exchange and preservation.

## **2. Macao's Portuguese-Style Cultural Connotation and Value**

The development of Portuguese culture in Macao, China has a deep historical foundation. Since the arrival of the Portuguese in the 16th century, interactions and integration with Chinese culture began to shape a distinctive cultural identity. Over centuries, this fusion evolved into a unique Portuguese-style culture characterized by diverse elements. Architecturally, it reflects a harmonious blend of Portuguese traditional designs and Chinese influences, as exemplified by landmarks like the ruins of St. Paul's. This site showcases intricate Western carvings while incorporating Oriental cultural motifs, symbolizing the synthesis of two traditions. The daily customs of the Portuguese community in Macao, China also embody this cultural amalgamation, with their language, attire, and festivals reflecting a seamless integration of Chinese and Western practices. Culinary traditions further highlight this fusion, as Portuguese cuisine in Macao, China retains its authentic flavors while adapting to local ingredients and cooking techniques, creating a distinctive gastronomic experience. This Portuguese cultural heritage is a vital representation of Macao, China's cultural diversity and serves as a historical testament to the exchanges between Chinese and Western civilizations. Preserving and promoting this cultural legacy is essential for fostering mutual understanding and enriching global cultural diversity. By safeguarding these traditions, Macao, China continues to play a significant role in facilitating cultural dialogue and exchange on an international scale [6].

## **3. The Status Quo of Digital Presentation of Portuguese Cultural Experience in Macao**

### ***3.1. The Existing Digital Practice***

Currently, Macau, China has implemented several digital projects to present and disseminate Portuguese cultural experience in a more accessible and systematic manner. Regarding online virtual visit platforms, the Cultural Affairs Bureau of Macau, China has

launched a dedicated virtual tour website that presents a range of buildings, heritage spaces, and museums associated with Portuguese cultural characteristics in Macau, China. Through this platform, users can conduct virtual visits and obtain knowledge of the relevant historical background, architectural features, and cultural meanings of these sites. Its main functions include the display of high-definition images, the provision of textual introductions, and the integration of audio explanations, which together enhance the clarity and depth of cultural interpretation. In addition, some digital interfaces improve user engagement by allowing more flexible browsing paths and repeated access to content, thereby supporting continuous learning. In terms of digital cultural activities, the "Tracing Portuguese Culture" initiative is a representative example [2, 7]. This activity releases online clues and tasks related to Portuguese culture and combines online participation with offline exploration. After completing online interaction, users can visit designated locations for further discovery. This integrated format enriches cultural communication, strengthens public awareness of Portuguese cultural heritage in Macau, China, and improves the practical effectiveness, interactivity, and educational value of cultural dissemination.

### *3.2. Multimodal Application Exploration and Existing Problems*

In the realm of multimodal applications, various exploratory efforts have been undertaken to integrate different sensory modes. For instance, the combination of visual and auditory elements has been employed to create immersive virtual tours. This approach merges images, videos, and audio explanations, allowing users to listen to detailed narrations while engaging with visual content. Such integration enriches the sensory experience and facilitates a more profound appreciation of Portuguese culture. Additionally, interactive features have been incorporated into online platforms, including functionalities such as question-and-answer sessions, comment sections, and participatory workshops. These workshops enable users to engage directly in activities related to Portuguese cultural practices, thereby enhancing their sense of involvement and connection. Despite these advancements, several challenges persist. From a technological perspective, the application of virtual reality technology has faced limitations due to high equipment requirements, which hinder accessibility for general users. Furthermore, digital resource compatibility remains inadequate, with difficulties in adapting content across diverse devices and platforms. On the cultural front, the narrative depth is insufficient, as the portrayal of Portuguese culture often lacks coherence and fails to delve into its deeper connotations. Cultural elements are frequently presented in a fragmented manner, which diminishes their overall impact. Regarding user experience, the design of interfaces requires significant improvement. Current designs are often overly complex, leading to operational difficulties. Additionally, the content is not updated in a timely manner, which limits its ability to meet evolving user expectations. Addressing these issues will be crucial for advancing the effectiveness and accessibility of multimodal applications, ensuring they provide both a seamless user experience and a comprehensive exploration of cultural narratives.

## **4. The Application Strategy of Multi-Modal Generative Narrative in Macao Portuguese Cultural Experience**

### *4.1. Building a Multi-Modal Narrative Framework*

To construct a multimodal narrative framework, the initial step involves planning narrative clues that are deeply rooted in cultural elements. For instance, the life transformations of native Portuguese can serve as a central theme. A clear narrative thread can be developed by tracing the origin and evolution of native Portuguese culture to its modern-day manifestations. This timeline-based approach allows for the sequential connection of life customs and cultural characteristics across different historical periods [8]. In designing a collaborative narrative that integrates multimodal elements, it is essential to harness the unique strengths of various modes and combine them in a cohesive manner. Architectural imagery, traditional Portuguese music, and narrative

texts can be effectively interwoven to create a rich cultural tapestry. For example, when illustrating the daily life of native Portuguese during a specific historical era, high-resolution images of relevant architectural landmarks can be displayed alongside popular Portuguese music from that period. Simultaneously, engaging narrative texts can provide context and depth, enabling users to immerse themselves in the cultural atmosphere of that time. This multi-sensory approach—encompassing visual, auditory, and textual elements—facilitates a comprehensive understanding of Portuguese culture, enriching the audience's experience and fostering a deeper appreciation of its historical and cultural significance.

#### *4.2. Enhance Technology Realization and Interactive Experience*

The integration of advanced technologies such as artificial intelligence and machine learning offers significant potential for creating content that highlights Portuguese culture. By leveraging these technologies, it becomes possible to generate personalized cultural narratives and design tourist routes that align with individual user preferences, thereby enriching their overall experience. Additionally, the incorporation of virtual reality and augmented reality technologies can provide users with an immersive cultural journey. For instance, VR equipment can simulate the internal structure and historical ambiance of Portuguese architectural landmarks, while AR technology can overlay virtual cultural information onto real-world environments, creating a seamless blend of the physical and digital realms. To further enhance user engagement, interactive narrative elements can be introduced. These could include task-based challenges within virtual environments, where users unlock new narrative content upon completing specific objectives [9]. Moreover, decision-making opportunities can be embedded, allowing users to influence narrative outcomes based on their choices, thereby fostering a dynamic and personalized storytelling experience. Another critical aspect is the adoption of a User Generated Content (UGC) model. This approach encourages users to actively participate by sharing their personal experiences related to Portuguese culture and creating content such as short videos and articles. Such contributions not only enrich the cultural repository but also cultivate a vibrant and collaborative atmosphere for cultural exchange and communication.

### **5. Case Analysis: Reference and Enlightenment**

#### *5.1. Analysis of Successful Cases of Cultural Digitalization at Home and Abroad*

The digitalization efforts of cultural institutions worldwide have demonstrated innovative approaches in technology, storytelling, and user engagement. For instance, a prominent museum in the United Kingdom employs advanced 3D scanning technology to create highly detailed digital models of its cultural relics. This allows for comprehensive and immersive displays of these artifacts. In terms of storytelling, the institution delves into the historical and cultural contexts of the relics, crafting rich and multi-modal narratives that are presented to users through various formats. To enhance user interaction, the museum has developed virtual exhibition halls and interactive features such as online games, which significantly increase user participation and engagement with the content. Similarly, the digitalization initiatives of the Palace Museum in China have yielded significant achievements. By leveraging multi-modal narrative techniques, the museum showcases the architecture and artifacts of the Forbidden City through diverse formats, including high-quality images, videos, audio recordings, and 3D models. These are made accessible via platforms such as the virtual Forbidden City and the digital cultural relics library. The integration of historical narratives and cultural contexts provides users with an enriched cultural experience, fostering a deeper connection to the heritage. These practices collectively highlight the potential of digital technologies to transform the preservation and dissemination of cultural heritage, offering valuable insights for future endeavors in this field.

#### *5.2. Enlightenment to the Digitalization of Portuguese Culture in Macau*

Drawing insights from successful cases, several strategies can be applied to enhance the digitalization of Portuguese culture in Macau, China. In terms of technological optimization, advanced methods such as 3D scanning technology, which has been effectively utilized in other cultural institutions, can significantly improve the precision and quality of digitizing cultural relics and architectural heritage [10]. Additionally, adopting practices that enhance platform compatibility and user experience, such as simplifying technological requirements, can make digital resources more accessible to a broader audience. This approach ensures that users with varying levels of technical proficiency can engage with the content seamlessly. Regarding narrative innovation, it is essential to deeply explore and present the cultural essence in a systematic and coherent manner. Employing diverse storytelling techniques, including situational narratives, can make the cultural content more engaging and relatable. Furthermore, improving user experience involves designing intuitive and user-friendly interfaces, ensuring timely updates to content, and incorporating interactive features that foster active participation. These measures not only enhance user satisfaction but also build long-term loyalty. By integrating these strategies, the digitalization efforts can effectively preserve and promote Portuguese cultural heritage in Macau, China, while ensuring that it remains relevant and appealing in the digital age.

## **6. The Influence of Multi-Modal Generative Narrative on the Inheritance of Portuguese Culture in Macao**

### *6.1. Expand the Scope of Cultural Communication and Audience*

With the aid of digital technology, multimodal generative narratives can transcend the constraints of time and space, enabling users from around the world to explore Portuguese culture in Macau, China, at any time and from any location via online platforms. From the perspective of communication geography, this approach establishes a "de-regionalized" cultural communication network through digital tools, effectively overcoming the traditional limitations associated with the preservation and dissemination of Macau, China's Portuguese cultural heritage. Conventional methods of cultural communication are often restricted by physical factors, such as the operating hours of museums or the accessibility of historical sites. In contrast, multimodal narratives leverage cloud storage and network transmission technologies, allowing users to access digital resources related to Portuguese culture without temporal or spatial barriers [11]. This form of communication not only broadens the reach of cultural dissemination but also enhances the frequency and depth of cultural engagement. Furthermore, the integration of advanced digital tools ensures that cultural heritage is preserved in a format that is both accessible and engaging for diverse audiences, fostering a more inclusive approach to cultural preservation and education.

In terms of audience reach, multimodal generative narratives address key challenges in cultural inheritance. Younger generations, particularly those categorized as Generation Z, exhibit a strong preference for interactive and personalized cultural experiences. By incorporating gamified narrative designs, such as virtual task completion and personalized content recommendations, multimodal narratives align closely with the media consumption habits of this demographic [12, 13]. Additionally, the inclusion of multilingual support and cross-cultural narrative capabilities ensures that audiences from diverse cultural and linguistic backgrounds can engage with Portuguese culture in Macau, China. For instance, non-Chinese users can overcome language barriers through the use of visual symbols and audio explanations, which facilitate an intuitive understanding of cultural elements. This approach not only enhances accessibility but also positions Macau, China's Portuguese culture within a global cultural dialogue framework. By utilizing familiar symbolic systems and interactive technologies, these narratives create a bridge for cross-cultural understanding, ensuring that the richness of Portuguese heritage in Macau, China, is effectively communicated to a global audience. This strategy

underscores the potential of digital tools to foster cultural exchange and mutual appreciation across different communities.

#### *6.2. Reconstruct the Practice Form and Value Identification of Cultural Inheritance*

From the perspective of cultural anthropology, the multimodal generative narrative fosters the active participation of individuals in the inheritance of Portuguese culture in Macao, China, thereby creating a transformative model. Traditional methods of cultural inheritance have often relied on unidirectional approaches, such as mentoring or the documentation of practices and traditions. However, multimodal generative narration introduces a participatory framework where audiences are encouraged to become co-creators of cultural content through user-generated contributions. For instance, individuals can engage in redesigning traditional Portuguese costumes within virtual environments, utilizing algorithms to generate new styles that align with cultural logic. Additionally, users can craft derivative stories inspired by historical events, which, upon review, can be integrated into a broader narrative database [14, 15]. This creative engagement not only deepens participants' sense of cultural belonging but also shifts the paradigm of cultural inheritance from static preservation to dynamic evolution. By fostering an interactive and participatory ecosystem, this approach establishes a new and sustainable model for cultural transmission.

In the realm of cultural memory construction and activation, multimodal generative narrative functions as a "digital memory carrier," offering innovative ways to preserve and engage with cultural heritage. The concept of cultural inheritance is often tied to both symbolic and intangible spaces, and digital technologies provide a means to bridge these dimensions. For example, the Ruins of St. Paul's in Macao, China, can be transformed into an interactive digital environment through high-precision modeling techniques. This approach allows for the restoration of its historical context by integrating multimodal elements [3]. Users can explore architectural details visually, listen to recordings of historical drama performances, and even view reconstructed performance scenes in video mode. Such immersive experiences not only enhance the audience's understanding of the historical and cultural significance of these sites but also strengthen their connection to the cultural memory. By leveraging these digital tools, the preservation of cultural heritage becomes more accessible and engaging, ensuring its relevance for future generations.

Equally significant is the role of multimodal generative narrative in shaping and reinforcing cultural identity [6]. The formation of a collective identity often requires shared cultural symbols and a cohesive narrative framework. By creating a digital narrative system centered on Portuguese culture in Macao, China, this approach fosters a stronger sense of cultural belonging among residents. Furthermore, the integration of elements that highlight the cultural interplay between China and Portugal—such as the fusion of architectural motifs and the blending of culinary traditions—serves to build a "cross-cultural community." This emphasis on cultural integration not only enriches the narrative but also ensures the continuity of Portuguese cultural heritage in a way that resonates with contemporary audiences. Through the dynamic interplay of digital storytelling and cultural representation, the ongoing existence and relevance of Portuguese culture are fundamentally secured.

### **7. Conclusion**

From the perspective of multimodal generative narrative, this study provides a comprehensive examination of the digital presentation and transmission of Portuguese cultural experiences in Macao, China. Through the analysis of relevant concepts, the study clarifies the connotation, practical significance, and application value of multimodal generative narrative theory in relation to Portuguese culture in Macao, China. It also reviews the current state of the digital presentation of Portuguese culture in Macao, China, and systematically identifies its main strengths and existing limitations. On this basis, the study proposes an application strategy for multimodal generative narrative in Portuguese

cultural experience design in Macao, China, including the construction of a multimodal narrative framework, the selection and integration of technical implementation paths, and the optimization of interactive experience. These aspects together form a relatively complete analytical and practical framework for future digital cultural projects. At the same time, by drawing on representative practical experience from different contexts, the study offers useful insights for the digital development of Portuguese culture in Macao, China. The overall findings indicate that multimodal generative narrative can effectively broaden the channels of cultural dissemination, expand the potential audience base, enrich the forms of cultural expression, and support the transformation of cultural heritage from static display to dynamic, participatory, and experience-oriented communication. In this sense, it not only improves the visibility and accessibility of Portuguese cultural resources in Macao, China, but also enhances their contemporary relevance and long-term sustainability in digital environments.

In the future, with the continuous advancement of digital technology, the application of multimodal generative narrative in the preservation, interpretation, and dissemination of Portuguese culture in Macao, China, is expected to become more extensive, refined, and in-depth. Further exploration may focus on the integration of more advanced intelligent technologies to generate richer, more adaptive, and more creative narrative content, thereby improving both expressive diversity and user engagement. At the same time, immersive technologies can be employed to create more vivid and coherent experiential environments, allowing users to interact with cultural content in ways that are more intuitive, participatory, and meaningful. However, technological development alone is not sufficient. Equal attention should be given to the systematic excavation, organization, and interpretation of cultural connotations so that digitally presented content remains accurate, representative, and contextually grounded. Future practice should therefore emphasize the coordinated development of content resources, narrative design, technical platforms, and user-centered evaluation mechanisms. Only through the balanced integration of cultural depth and technological innovation can the digital preservation of Portuguese culture in Macao, China, achieve both academic value and practical effectiveness, while providing a stronger foundation for sustainable cultural transmission, public engagement, and high-quality experiential communication.

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