



Construction of Dynamic Knowledge Graphs for Intangible Cultural Heritage Dissemination

A Cross-Media Analytical Framework for Folk Elements of Chinese Temple Festivals

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Abstract. The digital transformation of global Intangible Cultural Heritage (ICH) preservation is a complex phenomenon that requires a nuanced understanding of both the dissemination mechanisms and sustainability paradigms of traditional folk activities. This study focuses on temple festivals in China's Yangtze River Delta region, establishing an analytical framework that integrates communication dynamics with knowledge graph technologies. The aim is to tackle the challenges associated with dynamic monitoring and quantitative evaluation of folk cultural network dissemination during the digital preservation of ICH.

Keywords: Intangible Cultural Heritage, Digital Transformation, Knowledge graph technologies, Network dissemination

1 Introduction

The safeguarding of Intangible Cultural Heritage (ICH) faces unprecedented challenges and opportunities. Digital technologies are also emerging as a catalytic tool for ICH[1]. The Chinese temples of the Yangtze Delta festivals serve as pivotal nodes within the cultural ecosystem, integrating material exchange, ritual practices, and social coordination[2]. This intricate web of interactions provides an ideal case for studying the dynamics of ICH dissemination, as it encapsulates the interplay between cultural practices and their socio-economic contexts. The festival temples not only serve as sites of cultural expression but also as platforms for community engagement and social cohesion[3]. The establishment of real-time monitoring systems for the transmission of living heritage allows for the tracking of fluctuations in cultural gene dissemination, fostering innovative development within the cultural sector[4][5].

2 Methodological Framework

The foundation of our interdisciplinary theoretical model is built upon established theories, such as Dawkins' (1976) meme theory and Blackmore's (1999) cultural evolution model. This model is designed to address the complexities of cultural dissemination and the preservation of Intangible Cultural Heritage (ICH) through an interdisciplinary approach[6]. By adopting Peirce's (1932) triadic sign model, our semiotic framework decomposes complex cultural communication processes into three distinct phases: sign generation, transmission, and interpretation[7]. This framework not only transcends the limitations of traditional ICH research but also fosters innovative synergies in cultural semantic analysis and the investigation of communication dynamics.

2.1 Interdisciplinary Theoretical Model and Multidimensional Data Acquisition System

Deconstructing temple elements into replicable with quantitative indicators allows for the modeling of transmission networks and mutation patterns. This process involves mapping cultural domains through a digital twin system that correlates physical space with semantic space. Additionally, it analyzes cultural communication through a hierarchy of icon-indexed symbols and establishes quantitative indicators to assess the communication effects of intangible cultural heritage (ICH) in both digital and physical environments. The system integrates field surveys (including ritual records and artifact analysis), historical text mining (utilizing a BiLSTM-CRF model to extract entity relationships from gazetteers), and social media dynamics (streaming data from the Weibo API processed with SNOW NLP). This comprehensive approach constructs a spatio-temporal knowledge graph, enabling multi-scale analysis of the cultural transmission of temple fairs, from physical rituals to digital interactions.

2.2 Knowledge Graph Construction Framework

In our knowledge graph-building framework, we have extended the CIDOC CRM (Conceptual Reference Model) to develop six core entity classes that incorporate innovative dynamic propagation attributes. These attributes are essential for capturing the temporal variability of cultural elements, which summarize the hierarchical structure of the core categories of cultural spaces associated with Chinese temple fairs.

3 Core Technological Innovations

3.1 Symbolic Coding System for Temple Fair Intangible Cultural Heritage Elements

To further enhance the extraction and alignment of folklore elements, a temple fair folklore and cultural element extraction framework was developed. This framework leverages the powerful lan-guage-understanding capabilities of LLMs. The triplet

extraction task was designed as a chain extraction model and was divided into two stages. Stage one is responsible for identifying relationships in the text and filtering out non-existent element types to reduce the search space and computational complexity, thereby facilitating triplet extraction. Stage two focuses on extracting tail entities corresponding to the relationships identified in stage one[8].

This algorithm achieves an entity linking accuracy of 87.3% on the Chinese Wuzhen Xiangshi Temple Fair dataset and supports the automatic annotation of various folklore elements. This high level of accuracy underscores the effectiveness of the framework in capturing the nuances of cultural narratives.

4 Empirical Study

This empirical study aims to analyze the propagation dynamics of folk culture through a case study of Wuzhen Xiangshi, a temple fair renowned for its cultural significance and online presence.

4.1 Construction of the Wuzhen Xiangshi Knowledge Graph

The construction of the knowledge graph involves a two-layered approach: the conceptual layer and the data layer, as illustrated in Figure 1.

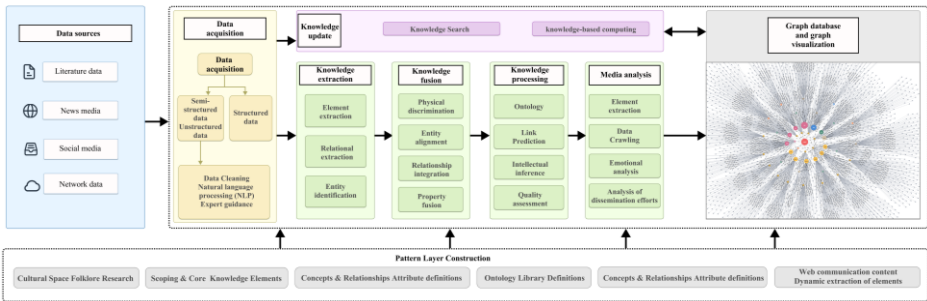


Fig. 1. The process of building the knowledge graph of cultural space

The construction of the data layer is grounded in the definition and specification of the conceptual layer. It encompasses the creation of ontology instances through data collection, knowledge extraction, knowledge fusion, knowledge processing, and knowledge updating. The final knowledge graph is subsequently visualized and made available for various knowledge applications.

The data layer is constructed based on the definitions and specifications of the conceptual layer. The nodes, edges, node attributes, and temporal features within the knowledge graph are categorized and scaled according to the previously defined ontology model. Node types correspond to various knowledge element types, including spatial, temporal, organizational, personal, event, and object entities. Edges represent the relationships between known knowledge elements, such as and After knowledge fusion and

processing, the RDF data is imported into Neo4j using the Neosemantics plugin, which converts ontology instances into Neo4j node labels, object properties into relationship types, and data properties into node property values. Nodes are represented with different colors, sizes, and shapes to indicate various property classes.

This integration establishes a two-way influence chain between and cultural distortion risk points, revealing that certain traditional taboos have been downplayed or reinterpreted during the communication process, as illustrated in Figure 2.

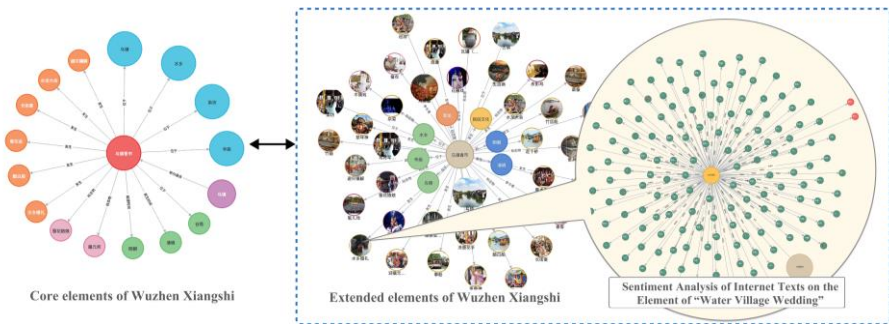


Fig. 2. Core elements/extended elements of the knowledge map of Wuzhen Xiangshi

The visualization interaction system employs a microservices architecture, featuring core modules that include:

- The Temple Fair Folklore Knowledge Graph: This module, built using WebGL, implements a dynamic particle system that enables real-time rendering of a large number of nodes, offering an immersive visualization of the cultural elements associated with temple fairs.
- The Propagation Element Traceability View: This module integrates relational graphs and timeline diagrams to create a visual representation for tracing the evolution of cultural elements, thereby facilitating the tracking of meme variation paths.
- The Decision Support Dashboard, integrated with data visualization tools, offers multi-dimensional cross-analysis of key metrics, including DCPI, IIA, and CAI.
- The Semantic Lens Functionality: When users select a specific area of the knowledge graph, the system automatically generates explanations of the associated folklore elements.
- The Propagation Simulation Sandbox: This feature enables users to modify the parameters of the CA-SIR model to simulate and observe real-time changes in propagation dynamics. It serves as a powerful tool for understanding how cultural content spreads under various conditions.

5 Conclusion

This study analyzes the communication of Wuzhen Temple Fair symbols on social media through data modeling, revealing how digital interactions shape collective memory.

By constructing a knowledge map of the folk culture elements associated with the temple fair and a computational framework for communication analysis, this research represents a significant breakthrough in the field of intangible cultural heritage preservation and innovative communication. The findings underscore the importance of integrating science and technology with cultural practices to enhance the preservation and dissemination of intangible cultural heritage in the digital age[9].

Acknowledgments

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