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Research on the Construction and Tourism Integration of Yunnan Ethnic Festival Culture Digital Database

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Abstract

Against the backdrop of deepening integration of digital culture and tourism, how to systematically protect and vitalize Yunnan's ethnic festival culture through technological means has become an urgent practical problem. Currently, although there is a rich variety of ethnic festival resources, there are challenges such as scattered digital collection, single presentation method, and unclear tourism transformation path. This paper explores the construction and application of the "Yunnan Ethnic Festival Culture Digital Database", proposes a systematic architecture integrating collection and integration, display and interaction, and real-time update, and constructs a path system for in-depth integration of the database and tourism. The research points out that only by relying on visual, intelligent and interactive digital means can the reconstruction of cultural memory and the translation of tourism value of ethnic festivals be realized, thereby promoting local cultural resources towards a win-win pattern of sustainable inheritance and industrial transformation.

Keywords

Yunnan ethnic festival culture; digital database; tourism integration; integration path

1 Research Background

Under the global trend of digital technology empowering cultural inheritance and industrial upgrading, the integration of digital culture and tourism has become the core path for the vitalization of cultural resources and the high-quality development of tourism [1]. As a region rich in ethnic festival culture in China, Yunnan is home to 25 indigenous ethnic minorities, nurturing hundreds of characteristic festival resources such as the Torch Festival and the Water-Splashing Festival. The folk rituals and artistic expressions they carry are important carriers of the diversity of Chinese culture. However, Yunnan's ethnic festival culture is currently facing practical difficulties such as lagging digital protection, scattered and fragmented resources, and inefficient tourism transformation. Traditional inheritance methods are difficult to adapt to modern communication needs, and the cultural value and tourism value have not been fully released. In this context, constructing a systematic digital database and exploring its in-depth integration path with tourism is not only an urgent need to solve the problem of cultural inheritance and protect cultural diversity, but also a key measure to promote

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the quality and efficiency of the cultural and tourism industry and realize the sustainable utilization of cultural resources.

2 Main Modules of Yunnan Ethnic Festival Culture Digital Database

2.1 Collection and Integration Module

The collection and integration module is the starting point for the construction of the digital database, responsible for the all-dimensional collection, standardized translation and structured filing of Yunnan's ethnic festival culture data. This module adopts various technical means such as image recognition, speech recognition, OCR document scanning, and geographic annotation to collect multi-source heterogeneous data in real time, including images, audio and video, text records, and folk oral accounts. All original data need to be translated into a unified format (such as JSON/XML structured data) and classified with tags according to metadata fields such as "festival name—ethnic affiliation—time node—geographic coordinates—expression form—cultural connotation" to facilitate subsequent indexing and retrieval. At the same time, to ensure the structural consistency and compatibility of data, the module embeds a data cleaning and automatic naming rule system, which can complete basic field filling, standardized file naming, duplicate detection and blank item prompts during the upload process, effectively improving the efficiency of data warehousing and quality control. The collection task is mainly triggered by a dynamic trigger mechanism based on festival nodes, which can trigger collection instructions according to set times or user-initiated submissions, realizing the collection logic of "data pre-positioning + dynamic warehousing".

2.2 Display and Presentation Module

The display and presentation module is the user-visible interface of the database, undertaking the tasks of information presentation of festival content and generation of digital experience. Based on a responsive front-end architecture (such as Vue.js/React), this module integrates 3D engines such as Three.js and WebGL to realize visualization operations and immersive browsing. In terms of content, the database aggregates images, videos, voices, texts and other data through multi-modality, supporting the coexistence of static display and dynamic interaction. The platform provides three display paths: "Festival Map", "Time Ring" and "Ethnic Classification", allowing users to quickly browse festival content based on spatial, temporal or cultural dimensions. Especially in the display of important festivals (such as the Water-Splashing Festival and the Torch Festival), technical means such as 360° panoramic images, gesture interaction, and dynamic models of festival dances are introduced to enhance the sense of cultural presence and immersive experience. At the same time, the module embeds data call interfaces (APIs) to support front-end integration with local cultural and tourism platforms and scenic spot smart navigation systems, making digital festival content not only a display object but also a medium and entrance for tourism service systems.

2.3 Retrieval and Interaction Module

The retrieval and interaction module is a key bridge connecting users and data, whose core task is to realize an efficient, intelligent and personalized information acquisition path. The bottom layer of the module uses

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a full-text search engine such as Elasticsearch to build a data indexing system, supporting functions such as keyword search, semantic association query, and multi-field combined filtering. By embedding word segmentation recognition and knowledge graph node matching mechanisms, the system can realize intelligent auxiliary retrieval such as festival synonym association, ethnic affiliation recommendation, and similar festival content push. To enhance localization and multilingual friendliness, the platform supports the input of ethnic languages such as Yi, Dai, and Jingpo, and automatically generates corresponding Chinese index results. At the interaction level, the platform has a user login mechanism, supporting two-way interactive behaviors such as collecting festival resources, uploading festival videos, and leaving comments, forming a closed loop of user behavior data feedback. Through user preference portraits and access path records, the system combines algorithm models to push "festival content you may like", realizing a "cultural recommendation engine" based on database data, making the retrieval process a cultural exploration journey.

2.4 Maintenance and Update Module

The maintenance and update module is the central system for the sustainable operation of the database, undertaking tasks such as data quality control, dynamic content iteration, and safe operation management [2]. Technically, this module integrates an automatic data comparison system and a timestamp update mechanism, which can real-time detect problems such as duplicate content, missing content, and format errors, and trigger content update prompts or automatic correction processes. The system has a version control logic, supporting historical data traceability and multi-round revision record query, ensuring that every data change is visible, traceable and controllable. In terms of update mechanism, the module designs a two-layer structure of "task pool + review workflow". Festival materials can be submitted by multiple subjects such as volunteers, scenic spot personnel, and folk custom museums. The platform realizes efficient review through a set review process (automatic + manual). At the operation and maintenance level, the system accesses data backup and abnormal alarm functions, regularly conducts database integrity scans and system vulnerability repairs to prevent data loss and illegal tampering. This module ensures the timeliness and technical stability of the database content, and is a key fulcrum for realizing the dynamic inheritance of cultural resources and the continuous vitalization of the platform.

3 Construction Countermeasures of Yunnan Ethnic Festival Culture Digital Database

3.1 Automatic Festival Classification Using Image Recognition

To improve the filing efficiency and accuracy of ethnic festival content, the construction of the database should introduce image recognition technology to realize automatic classification and annotation of festival image data. By deploying a deep convolutional neural network (CNN) model, feature extraction and pattern matching can be performed on costume elements, activity scenes, festival props, etc. in uploaded pictures or videos, so as to quickly determine the ethnic group, activity type and environmental labels of the festival. The system can build a training set based on the existing sample library, such as the basin and water gun elements of the Dai Water-Splashing Festival, the bonfire and queue images of the Yi Torch Festival, etc., and achieve high-precision comparison and automatic filing with the help of image similarity algorithms. At the same

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time, the platform should support manual error correction and machine learning iterative update mechanisms, so that the image recognition system can continuously optimize the recognition accuracy during use. This strategy can greatly reduce the pressure of manual classification and provide a foundation for the database to build a structured and multi-dimensional visual data indexing system.

3.2 Ethnic Language Input with Speech Recognition

A large amount of cultural content in Yunnan's ethnic festivals is spoken or sung in dialects and ethnic languages. The traditional manual recording and transcription method is inefficient and has a high error rate [3]. To realize the rapid digital transcription of ethnic language materials, the database can access a multilingual speech recognition system, adopt end-to-end speech transcription models (such as DeepSpeech, Whisper, etc.), automatically convert audio into text, and synchronously label metadata such as speakers, language types, and timelines. For characteristic languages such as Dai, Yi, and Jingpo, cooperation with local universities can be carried out to build dialect corpora to enhance the model's recognition ability. In terms of page presentation, the text content can be accurately corresponding to the audio through timestamps, facilitating users' review and citation. In addition, the data after speech transcription can also be used as a source of natural language processing (NLP) analysis for subsequent function expansion such as cultural theme mining and festival narrative structure analysis, truly realizing multi-level data derivation of "language—text—semantics".

3.3 Festival Area Annotation Through Geolocation

Geographic information is an important component of the festival culture database, which helps to realize spatial visualization presentation and regional cultural research. During the construction process, a GIS module and a GPS geocoding system should be embedded to collect the longitude and latitude coordinates of festival venues, and realize functions such as map positioning and heat map distribution. At the data collection end, it supports automatic embedding of positioning information when collecting with mobile devices or drones; at the data management end, a visual map anchor is set for each festival entry, and layers such as ethnic distribution maps and tourism flow maps are superimposed to realize data linkage of "festival—location—crowd". In the front-end display, users can retrieve the distribution density of festivals and the characteristics of activity areas through the map, forming a cultural cognitive structure in the spatial dimension. In addition, geographic information can be combined with the time dimension to generate a "festival spatio-temporal map", supporting advanced functions such as time series query and regional cultural change analysis, which is an important support for the future expansion of the database.

3.4 Building Convenient Upload Channels with Multi-End Entrances

The real-time performance and extensiveness of data depend on an efficient upload mechanism. To improve the collection coverage of festival culture data, the database needs to build a multi-end entrance system of "web terminal + mobile terminal + mini program" to meet the convenient upload needs in different usage scenarios [4]. The platform should develop standardized upload templates, covering data types such as images, videos, voices, and documents, and be equipped with guided form-filling functions, such as automatic completion and prompt functions for fields such as festival name, ethnic affiliation, activity description, time and

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place, to reduce the upload threshold. In terms of technical architecture, APIs can be used to access the digital systems of local cultural centers, schools, village communities, etc., to realize collaborative warehousing of multi-source data. To ensure data quality, the platform sets up a content review mechanism and configures a primary intelligent review model for duplicate detection, low-quality elimination, format unification and other operations. Driven by both technological empowerment and diversified entrances, the database can continue to expand and maintain content vitality, providing a stable data base for subsequent applications.

4 Tourism Integration Path of Yunnan Ethnic Festival Culture Digital Database Construction

4.1 Launching Festival Digital Maps to Guide Tourists to Punch in Precisely

As a key carrier connecting cultural resources and tourism services, digital maps can effectively carry the integration channel between festival spatial distribution, cultural information and tourist behavior [5]. Based on the Yunnan Ethnic Festival Culture Digital Database, a trinity visual interactive map system of "festival + map + navigation" should be constructed. At the bottom layer architecture, GIS spatial information technology is integrated with festival data fields to realize geographic anchoring, heat distribution and time axis linkage of activity venues. Each festival location not only marks the geographic location but also links to festival introductions, ethnic customs, costume symbols, main ceremony videos and other content, enhancing the depth and breadth of cultural understanding. In terms of function design, task-based check-in systems such as "targeted check-in", "festival puzzle" and "intangible cultural heritage exploration" can be developed for tourists to complete offline tours according to interests, routes or ethnic series. The map system should also access real-time traffic, accommodation and smart navigation interfaces to improve the full-process experience of tourists. In addition, the festival map can also have a function of "generating my ethnic festival tour", supporting tourists to generate one-click itinerary recommendations after checking their preferences, realizing the active matching of cultural resources and tourism routes, thereby promoting the landing application of "content as a service". To enhance the interactivity and service depth of the festival digital map, dynamic interest recognition and personalized recommendation algorithms can be further introduced to automatically optimize the sorting of festival locations and content display priorities according to tourists' browsing records, click behaviors and check-in preferences, forming a "thousand people, thousand maps" cultural and tourism navigation experience. The system can also set a dynamic "time window" flash mechanism for festival activities, push upcoming festival projects in advance, and superimpose AR prompt navigation to enhance tourists' perception of festival time and space. At the same time, the map should be bound to the user's location, providing services such as "nearest festival to current location", "real-time traffic avoidance suggestions", and "festival crowd monitoring", building an intelligent navigation system integrating route planning, cultural introduction and service linkage. In addition, to facilitate tourists to review their itineraries and retain experiences, the platform can generate a digital commemorative map of "my festival travel notes", including check-in points, watched videos, completed tasks and other information, realizing the digital trace of cultural behaviors and strengthening the emotional value and communication willingness of tourists' festival experiences.

4.2 Strengthening Festival Immersive Content to Enhance Digital Tourism Experience

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4.3 Constructing Virtual Festival Scenes to Attract Remote In-depth Tours

Based on 3D modeling and virtual reality (VR) technology, representative ethnic festival scenes can be virtually restored, such as the Dai Water-Splashing street scene, the Yi Torch Night Banquet, and the Bai Three-Course Tea Ceremony [6]. Using images, videos, audios and other materials collected in the database, a navigable and interactive digital festival environment can be built with the help of modeling engines (such as Unity or Unreal Engine). Tourists can immerse themselves in the festival world through web terminals, mobile terminals or VR devices, and experience modules such as virtual dance parades, character interactions, and cultural explanations. Interactive units such as voice navigation, question-and-answer challenges, and festival legend animations can be set in the scene to enhance the participation of remote users. The back-end system optimizes the content structure through user behavior data analysis, realizing a linked closed loop of "festival + immersion + data", which not only expands non-on-site participation methods but also provides a digital entrance for Yunnan's festival tourism to attract local and foreign tourists.

4.4 Setting Interactive Check-in Tasks to Enhance Tourists' Participation Enthusiasm

Combining database content with mobile positioning technology, a "digital task chain" centered on festivals can be constructed to guide tourists to check in online and offline. For example, during the Water-Splashing Festival, tourists can receive "festival task cards" through mini programs, and complete interesting tasks such as "uploading folk costume photos", "dancing ethnic dances with NPCs", and "identifying five totem patterns". The system verifies the validity of behaviors through image recognition and geographic location matching. After completing the tasks, the system automatically issues virtual rewards such as "digital badges", "festival collection cards", and "ethnic specialty coupons" to enhance user stickiness and cultural immersion. At the same time, the background records tourists' completion paths and preference data, providing a basis for thermal analysis and festival service optimization for scenic spot operations. This mechanism effectively connects cultural content, gamification mechanisms and tourism behaviors with the help of LBS services, image recognition, user portraits and other technical means, constructing a new type of festival participation model under digital guidance.

4.5 Linking Smart Scenic Spot Systems to Push Real-Time Festival Information

The festival database should realize data interconnection with local smart scenic spot systems to achieve two-way linkage between festival activities and tourist service information [7]. Technically, the festival time, location, activity details in the database are synchronized with the scenic spot management platform through API interfaces. When tourists enter the scenic spot, they can receive real-time pushes, such as "today's ethnic dance performance schedule", "best viewing spots for sacrificial activities", and "suggestions for avoiding peak hours". In addition, the system can implement personalized push strategies through crowd monitoring and tourist tag data (such as age, preferences, language). Users can also call the festival knowledge module through voice assistants, scan codes for recognition, etc., to obtain cultural background and viewing suggestions, enhancing the depth of cultural understanding during travel. This plan integrates technologies such as the Internet of Things, data middle platform, and tourist behavior perception, integrating festival culture into the smart scenic spot service chain, and promoting the in-depth integration transformation of "activity visualization, information intelligence, and tourist service personalization".

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5 Enriching Digital Cultural and Creative Products to Extend the Festival Consumption Chain

5.1 Extracting Visual Cultural Elements to Create Festival Cultural and Tourism Symbols

Relying on the visually structured festival costumes, artifacts, totem patterns and other visual elements stored in the database, a cultural element database can be built through image recognition and visual clustering algorithms [8]. The system can automatically extract high-frequency graphic symbols and label them with semantic tags according to cultural connotations, such as "Dai elephant-foot drum totem" and "Yi flame pattern". On this basis, cultural and creative teams can use AI-assisted design platforms (such as Midjourney, Runway ML) to convert them into application materials such as digital posters, IP images, and festival digital collectibles, thereby expanding the festival cultural and tourism product matrix. Cultural and creative symbols can also be embedded in festival map interfaces, tourist task cards, and online festival exhibitions to form a unified visual identification system and enhance cultural identity. This approach, through the path of "digital extraction—symbol creation—multi-dimensional distribution", not only improves the recognition of festival culture but also provides a content source for the linkage between digital products and offline commodities. To realize the multi-platform transformation of visual cultural elements, an API-level content authorization mechanism should be further developed to enable different platforms and brands to call cultural elements in the image database according to standard agreements for application scenarios such as festival-themed commodities, cultural and tourism promotion, and short video filters. At the same time, festival graphic symbols can be converted into tradable digital collectibles (NFTs), and blockchain technology can be used to record their uniqueness and cultural traceability, attracting young users to participate in cultural collection and secondary creation. For offline application scenarios, an AR-based real-scene "festival visual recognition" system can also be developed. When users scan ethnic costumes and totem sculptures in scenic spots, they can trigger cultural explanations, story interactions or festival blessing animations, stimulating sensory memory and immersive interest. This extended method of "cultural visual elements + digital interactive applications" not only improves the cognitive breadth of festival culture but also injects sustained growth momentum into the local cultural and creative ecosystem.

5.2 Developing Multilingual Content Packages to Expand Overseas Communication Channels

To enhance the international communication power of Yunnan's ethnic festivals, multilingual festival digital content packages supporting Chinese, English, Japanese, Dai, Yi and other languages should be developed based on the database . Each content package can include information such as festival origins, activity processes, viewing etiquette, characteristic cuisine, and taboos, integrating short video explanations, illustrations and comics, interactive animations and other forms to create lightweight and embeddable cultural communication products. The content can be targeted pushed through social media platforms (such as YouTube, Instagram, Xiaohongshu International Version), or embedded in overseas cultural and tourism nodes such as OTA platforms, embassies and consulates' official websites, and online booths of international travel exhibitions. At the same time, an automatic response mechanism for tourists' questions can be realized through AIGC (such

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as ChatGPT API) to provide real-time festival cultural consultation services. This strategy realizes a collaborative communication path of "database + AI translation + scenario-based content distribution", effectively expanding the contact channels and cultural affinity of overseas users. In addition, a multilingual content precise recommendation model can be built based on user portraits, automatically matching corresponding language content packages according to users' native language, access region, and browsing behavior to improve communication accuracy. The platform can also set up a "festival voice quick overview" function, supporting tourists to listen to concise festival voice guides through headphones, realizing a low-interference and efficient way of cultural acquisition. For international study tour groups and travel bloggers, in-depth content download permissions and cooperation interfaces can be opened to encourage secondary communication and localized creation, building an international communication ecosystem of "multilingual—multi-scenario—multi-subject" co-creation and co-broadcasting.

5.3 Opening Up Data Resource Interfaces to Realize a Closed Loop of Cultural and Tourism Integration

Opening up data resource interfaces is the core measure to realize the in-depth integration of the database and cultural and tourism scenarios . Currently, the data between cultural and tourism departments at all levels, scenic spot management systems, OTA platforms and folk custom museum digital platforms are fragmented, hindering the efficient circulation of festival resources. The database should build unified data call standards, open API interfaces, support multi-platform data intercommunication, and allow third-party systems to call resources such as festival content, schedules, activity videos and cultural introductions. Specifically, it can promote content docking with local cultural and tourism clouds, smart city platforms, Douyin local life, Ctrip/Fliggy Tourism and other platforms to realize the automatic embedding of festival recommended content. At the same time, a "data return" mechanism should be established synchronously to allow user behavior data from third-party platforms (such as click rate, visit duration, collection volume, comment keywords) to be directionally fed back to the database background, forming a quantitative evaluation of festival content popularity and tourism transformation effects. The platform can optimize the content presentation logic based on this to improve the precise supply capacity of cultural data. In addition, it is recommended to establish a "Festival Data Interface Sharing Alliance" to promote the co-construction and sharing of cultural and tourism data in various prefectures and cities in Yunnan under a unified agreement, avoid duplicate construction, and improve data utilization efficiency. At the user end, a "festival as a service" digital middle platform should be built to realize an integrated process from content discovery, route generation, ticket purchase to on-site navigation. The platform can access various usage scenarios through mini programs, Apps, touch terminals, etc., providing tourists with a one-stop cultural and tourism experience of "watching festivals, checking itineraries, placing orders, and listening to explanations". Through multi-terminal synchronous sharing of data, it not only improves the exposure and transformation power of festival resources but also feeds back the precise expansion and structural optimization of database content, thereby forming an efficient operation logic of "data—content—service—feedback" four-in-one, truly realizing the in-depth integration of ethnic festival culture and tourism industry.

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6 Conclusion

In summary, the spiritual imagery and ritual energy contained in Yunnan's ethnic festival culture are being reactivated and disseminated under the empowerment of digitalization. With the database as the fulcrum, integrating intelligent technology and cultural and tourism scenarios not only expands the modern survival method of cultural heritage but also opens up a more vibrant path for the diverse sharing and international expression of national memory.

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