

Design and Implementation of Rural Culture and Tourism Software based on Wechat Small Program

-- Take the "Yushang Rice Township" Mini Program as an Example

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Abstract: With the advancement of the rural revitalization strategy and the rapid development of mobile internet technology, as well as the application and advantages of Wechat Mini Programs in rural cultural tourism. This paper takes the "Yushang Rice Township" Mini Program as an example to explore the design and implementation of rural cultural tourism software based on Wechat Mini Programs. The article first analyzes the current status of rural cultural tourism development and the advantages of Wechat Mini Programs, then elaborates on the requirement analysis, system design, and functional implementation of the "Yushang Rice Township" Mini Program. Finally, it summarizes the project's characteristics and innovations, and looks forward to future development directions.

Keywords: Wechat Small Program; Rural Culture and Tourism; Yushang Rice Village; Software Design; Rural Revitalization.

1. Introduction

In recent years, government of PRC has actively promoted the rural revitalization strategy, bringing new development opportunities to the rural cultural and tourism industry. According to the "China Rural Tourism Development White Paper 2024" released by Fastdata, in the first quarter of 2024, the number of visitors to rural areas approached 800 million, with the number of rural tourism operators increasing by 18% year-on-year. This indicates that the tourism industry plays a crucial role in the revitalization of the rural economy. Statistics show that in 2023, the output value of China's rural tourism exceeded 900 billion yuan, with the per capita tourism income for farmers reaching 1,903 yuan. The tourism industry is intricately linked with many other aspects of rural development. Developing rural tourism not only promotes the improvement of local infrastructure and activates rural tourism resources, helping farmers increase their income and achieve prosperity, but also drives the comprehensive realization of rural prosperity and revitalization. Additionally, it helps protect Chinese traditional culture nurtured in the countryside, providing more cultural elements to foster national cultural confidence.

The construction and operation of rural tourism projects currently face numerous challenges, particularly the shortage of talent. This has led to weak marketing efforts in many rural tourism projects, thereby affecting their economic benefits. Moreover, traditional methods of promoting rural cultural and tourism activities suffer from low information dissemination efficiency and poor user experience, failing to meet the needs of modern tourists. Wechat Mini Programs, with their lightweight and easily shareable characteristics, have opened up new paths and solutions for the development of rural cultural and tourism activities. Taking the "Yushang Rice Township" Mini Program as an example, it focuses on rural cultural and tourism activities while emphasizing user sharing and interaction. It creates a professional, humanized, and intelligent platform that integrates services such as

accommodation, navigation, social networking, live streaming, direct purchase of local specialties, educational tours, and customized travel experiences. This ensures maximum safety for tourists and maintains order in the tourism industry while enhancing their experience and satisfaction.

This project iteratively upgraded and designed a shared interactive platform for rural cultural tourism in the post-pandemic era, based on the "Rice Fragrance Town" Wechat mini-program originally located in Yong'an Village, Yuhang District, Hangzhou City, Zhejiang Province, China. The "Yushang Rice Township" Wechat mini-program offers a range of services including smart navigation, transportation and accommodation, interactive social networking, educational classes, personal center, and digital adoption. By promoting new retail in rural areas through methods such as "digital adoption" of crops, it fosters a new model of agricultural tourism development that combines the upward flow of agricultural products with the downward flow of tourists.

2. Overall Framework of Yushang Rice Village APP Project

The digital system of Yushang Rice Village APP is a comprehensive service platform based on the Internet of Things (IoT), big data, geographic information system (GIS) and cloud computing technology. It aims to empower agriculture, culture and tourism and rural governance through technology, and realize digital and intelligent upgrading.

As shown in Figure 1, the digital system of Yushang Rice Township is divided into five layers, which are introduced as follows:

2.1. User Layer

The system users cover four categories: regulatory authorities, administrative departments, farmers and tourists/consumers. It supports multi-terminal access, including PC terminal, mobile terminal (such as H5, small

program, APP) and visual large screen, etc., and adopts single sign-on (SSO) technology to achieve unified identity

authentication, ensuring account security and operation convenience.

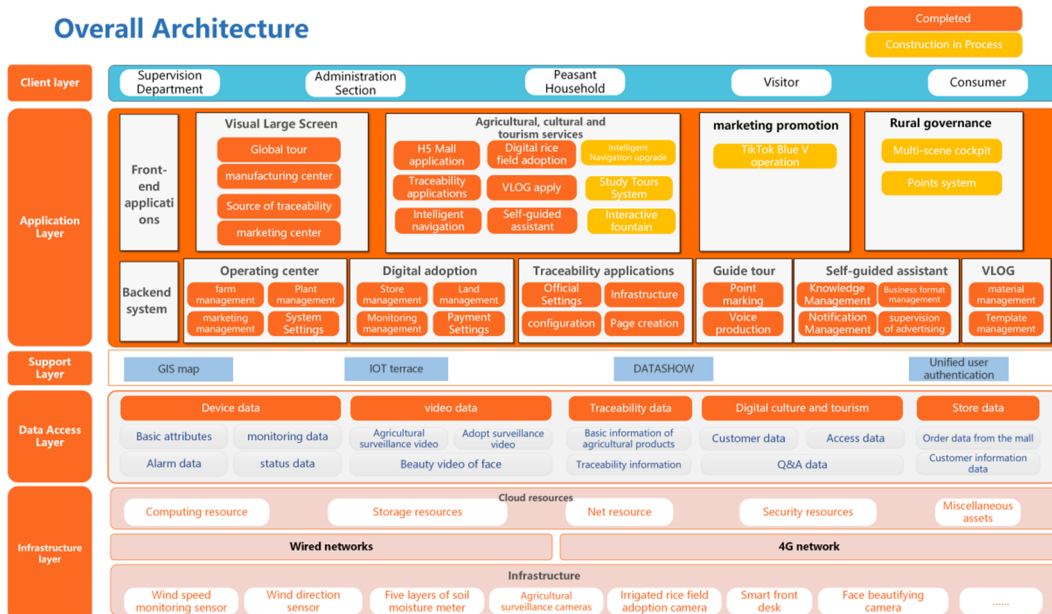


Figure 1. System Architecture of Yu Shang Rice Township

2.2. Application Layer

2.2.1. Front-end Applications (User Interaction Layer)

Developed based on data visualization tools, it integrates real-time data streams (such as sensor data, order data), and uses dynamic charts (line chart, heat map, 3D map) to display core indicators such as agricultural production status, passenger flow distribution, revenue analysis, etc.

2.2.2. Agricultural, Culture and Tourism Services:

2.2.2.1 Digital Rice Field Adoption:

Use the Internet of Things (IoT) sensor to collect real-time environmental data of rice fields, including temperature, humidity and soil moisture content, and use block-chain traceability technology to comprehensively record every link from planting to maintenance and harvesting, so as to ensure the authenticity and reliability of data.

2.2.2.2 Intelligent Navigation System:

The intelligent navigation of scenic spots is realized through GIS map engine (such as Mapbox or Gaode Map API), combined with the exquisite design of hand-drawn map, and integrated with speech recognition (NLP) and AR augmented reality technology, so as to bring immersive navigation enjoyment for tourists.

2.2.2.3 Study Service and VLOG Application:

Through AI video editing tools (such as FFmpeg, OpenCV) and template content production system, users can quickly generate study course videos and travel Vlogs.

2.2.3. Marketing Promotion:

Connect with TikTok Blue Verification API to realize automatic distribution of short videos, live streaming diversion and user interaction data analysis; combine with precision marketing algorithm (such as collaborative filtering recommendation) to push personalized cultural tourism products to tourists.

2.2.4. Management Background (Operation Support Layer)

Operation Center: Developed based on microservice architecture (Spring Boot/Django), it supports farm resource

management (crop types, plot allocation), order processing, payment reconciliation and other functions, and adopts RESTful API to connect with front-end and third-party systems.

2.3. Support Layer

2.3.1. GIS Map Platform:

vector tile technology is adopted to optimize map rendering performance, and spatial data division (such as regional division) is supported.

2.3.2. IoT Platform:

Real-time communication of devices is realized based on MQTT protocol, and data preprocessing is carried out through edge computing gateway (such as Raspberry PI) to reduce the cloud load.

2.3.3. Big Data Analysis:

Use the stream processing framework (such as Kafka Streams, Flink) to process real-time data, and combine offline analysis tools (Hadoop/Spark) to mine user behavior patterns and production rules.

2.3.4. Unified Authentication and Permission Management:

OAuth 2.0 protocol is adopted to realize third-party account login, and RBAC (role-based access control) is combined to ensure data permission isolation.

2.4. Data Access Layer

2.4.1. Multi-source Data Integration:

2.4.1.1 Equipment Data:

Access sensor data (wind speed, soil moisture, etc.) through Modbus/TCP, OPC UA** and other industrial protocols.

2.4.1.2 Video Data:

RTSP streaming media protocol is used to access the surveillance camera, and video AI analysis (such as crop pest identification) is supported.

2.4.1.3 Traceability Data:

The production information is automatically recorded

through the blockchain smart contract to prevent data tampering.

2.4.2. Data Storage:

2.4.2.1 Real-time Data:

sensor data is stored in a time series database (InfluxDB/TSDB).

2.4.2.2 Business Data:

The relational database (MySQL/PostgreSQL) is used to store structured data such as orders and users.

2.4.2.3 Unstructured Data:

Images, videos and other files are stored through object storage (OSS/S3).

2.5. Infrastructure Layer

2.5.1. Hardware Facilities:

2.5.1.1 Sensor Network:

deploy multi-layer soil moisture meter (supporting 5 layers of soil detection), agricultural weather station (temperature and humidity, wind speed), paddy field camera (supporting night vision and AI recognition) ** and other Internet of Things devices.

2.5.1.2 Edge Computing:

Use industrial-grade gateways (such as Advantech and Siemens) for local data filtering and protocol conversion.

2.5.2. Cloud Services:

2.5.2.1 Computing Resources:

Deploy application services based on cloud servers (ECS/EC2), and use containerization technology (Docker/Kubernetes) to achieve elastic scaling.

2.5.3. Network and Security:

Load balancing (SLB), DDoS protection and HTTPS encryption are adopted to ensure service stability and data transmission security.

2.5.4. Storage and Backup:

Data persistence is realized by using cloud disk (RDS/S3), and the disaster recovery capability is improved by combining remote multi-active architecture.

2.6. Technical Highlights and Construction Objectives

2.6.1. AI and Big Data Application:

1) Crop growth status monitoring and pest and disease early warning through computer vision (CV).

2) Use user behavior analysis model to optimize cultural tourism route and product recommendation.

3) Application of alliance chain technology in the traceability system of agricultural product quality and safety. Through the establishment of an alliance blockchain network, data sharing and security are ensured to realize the whole process of credible traceability of agricultural products from planting to sales.

The system integrates the real-time perception technology of the Internet of Things, the decision-making ability of big data analysis and the elastic scalability of cloud computing, and jointly constructs an integrated digital ecological environment of agriculture, culture and tourism, providing users with intelligent services along the whole link and scientific data support for managers, to promote the sustainable development of rural industries.

3. Related Technologies

3.1. System Functional Module Design and Implementation

The "You Xiang Jia" Wechat Mini Program client operates on the Wechat Public Platform. Its information is uniformly managed by the backend management system, while the server side relies on the backend server for management, and data is stored in a MySQL database. The operation interface of the "You Xiang Jia" Wechat Mini Program is divided into four main sections: "Home, Itinerary, Community, and Me," as shown in Figure 2.

3.2. Overall System Architecture Design

The APP software is the core component of the "Yushang Rice Township" digital project, comprising four main pages: Home, Guide, Square, and My. The top layer of the Home page includes eight modules: Farm Mall, Leisure and Entertainment, Premium Homestays, Nearby Tours, Smart Adoption, Visitor Reception, Business Space, and Recommendations; the lower layer is divided into "Rural Brand Pavilion" and "Popular Events." The Guide page features a hand-drawn tourism map of the surrounding eight villages centered around Yong'an Village. The Square page mainly displays travel diaries shared by various tourists in Rice town for user viewing. The My page consists of two major modules: My Orders and Tool Area. My Orders includes sections such as "To be paid," "To be received," "To be Used," and "To be evaluated." Tools include "Real Name Verification," "Visitor," "Vlog" "Delivery Address," "My Farm," "Coupons," "My Travel Diaries," "My Study Tours" & "Business Card Holder", as shown in Figure 2.

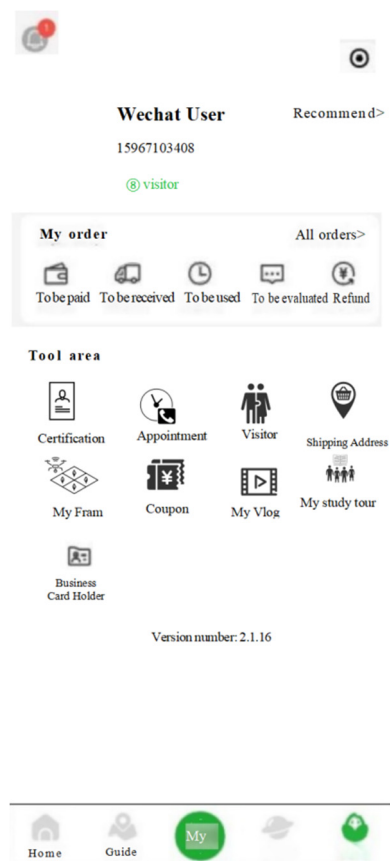


Figure 2. Square page Page of App

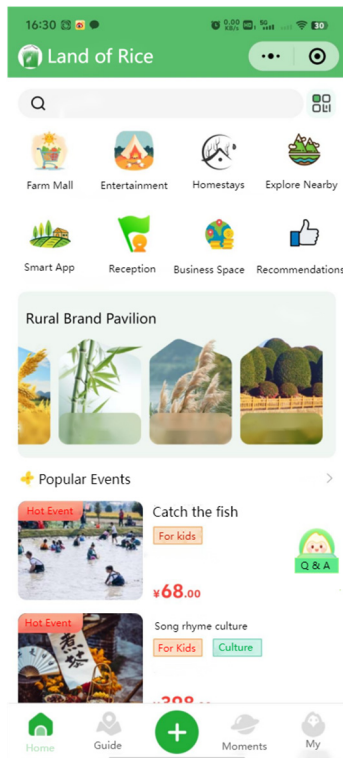


Figure 3. Home Page of App

Home Page: The design is divided into two levels. As shown in Figure 3, the upper level of the home page includes functional modules such as the search box, "Farm Mall," "Entertainment," "Homestays," "Explore Nearby," "Smart App," "Reception," "Business Space," and "Recommendations." Below these functional modules are sections like "Popular Events" and the Rural Brand Pavilion. Users can find their desired countryside and related popular events on the home page, as well as browse travel information recommended by the App.

The top layer of the home page is a search box. Users can search for their own activities of interest to browse, and clicking on the activities on this page will jump to the details page, where you can learn more content.

3.3. Visitor Registration

In the registration login page of the APP, HTML pages use form to build the form structure so that users can fill in and submit the required information. When users register, the uniqueness of the phone number is verified to prevent repeated registration resulting in redundant data. The following only shows part of the core code:

```
String sqlCheckPhone = "SELECT COUNT (*)
FROM user WHERE telephone = ?";
try (PreparedStatement pstmt = conn.prepareStatement
ent (sqlCheckPhone)) {
    pstmt.setString (1, telephone);
    try (ResultSet rs = pstmt.executeQuery ()) {
        if (rs.next () & rs.getInt (1) > 0) {
            out.println (" This phone number is registered, please go
directly
            entry.");
        } else {
            / The phone number does not exist. Insert a new user (omit
the insert
            Enter logic)
        }
    }
}
```

3.4. Database Design

This software uses SQLite database as the background database. It mainly includes user table, order table, commodity table, shopping cart table and so on.

1 User table: used to store user information. The design of the user table is shown in Table 1.

Table 1. User table design

field name	data type	remarks
Uid	int	User ID (primary key)
Username	varchar	user name
Password	varchar	password
Phone	number	telephone
Address	varchar	address
Signature	varchar	sign one's name
Gender	char	sex
Name	varchar	Real name
Login	char	Login status
Heading	varchar	head sculpture

2 Order table: This table stores the transaction orders of the App. The order table is set up

See Table 2.

Table 2. Order table design

field name	data type	remarks
Oid	int	Order number (primary key)
Uid	int	Transaction user ID (foreign key)
Start_time	Date	opening
status	varchar	Transaction status
End_time	Date	End of the transaction
Gid	varchar	Item number (foreign key)

3 Product table: This table is used to store all agricultural products information of the App. The design details of the

product table are shown in Table 3.

Table 3. Design of commodity table

field name	data type	remarks
Gid	int	Item number (primary key)
Gname	varchar	trade name
Gprice	double	price
Gdescription	varchar	description

4 Shopping cart table: This table is used to store the shopping cart information of users. The design details of the

shopping cart table are shown in Table 4.

Table 4. Shopping cart table design

field name	data type	remarks
Cid	int	Shopping cart ID (primary key)
Uid	int	User ID (foreign key)
Cnumber	int	Quantity of goods
Ccount	double	total sum
Gid	int	Product ID (foreign key)

4. Technical Difficulties

4.1. Data Encryption

As security vulnerabilities increase, app security has been a major concern for developers. Given that this App involves sensitive information such as users' personal data, location data, and transaction data, it is essential to provide reliable security measures to prevent information leaks and unauthorized use. To this end, the App employs MD5 encryption technology, which effectively prevents data leakage during transmission or storage. When sensitive data needs to be forwarded or stored, the data to be encrypted is first obtained, then processed using the MD5 encryption algorithm. The encrypted data is transmitted next to prevent information leakage during transmission. After receiving the data, the MD5 algorithm is used again to decrypt it, and the decrypted data is stored. This process effectively protects users' personal privacy and ensures that the App complies with legal requirements for data privacy and security. The specific working principle is shown in Figure 4.

4.2. Improve Response Speed

For an application, the speed of response directly impacts user experience. Users tend to prefer apps that respond quickly, as they offer smoother and more efficient operations. Long waits and delays can make users impatient, potentially leading to user churn. To improve the responsiveness of an App, data that users have already browsed should be cached on the phone. When users do not clear the App's cache.

When you need to access the data that has been viewed again, you can directly call it from the cache without accessing the background. This method can improve the response speed of the App. The specific working principle is shown in Figure 5.

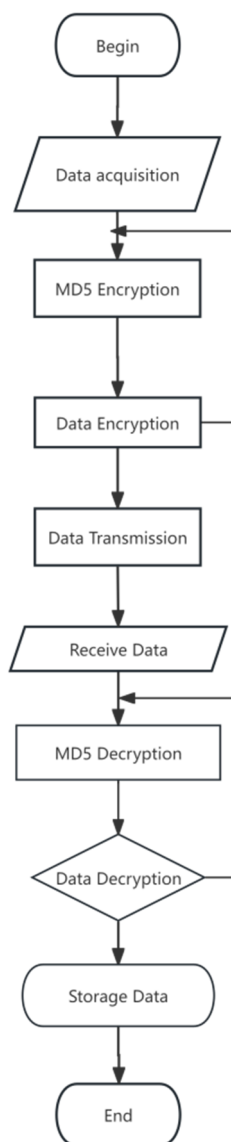


Figure 4. Data encryption workflow diagram

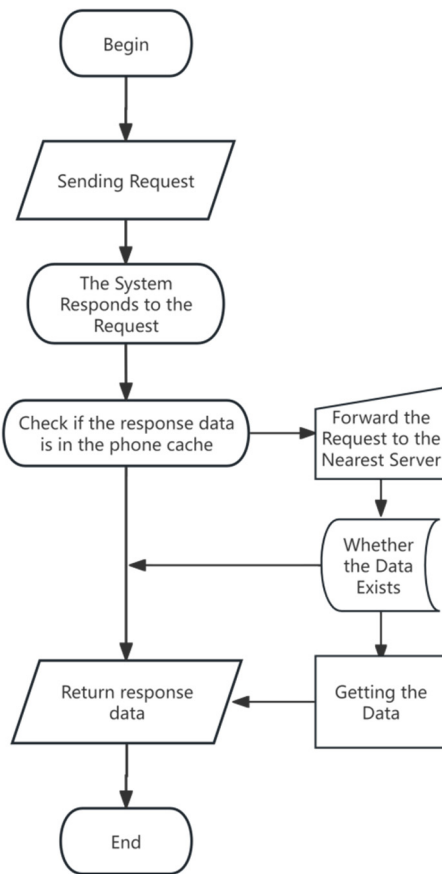


Figure 5. Workflow diagram for improving response speed

4.3. Key Code

```

{
  "pages": [
    "pages/index/index",
    "pages/destination/destination",
    "pages/destination/cityView/cityView",
    "pages/index/view-detail/view-detail",
    "pages/find/find",
    "pages/personal/personal",
    "pages/personal/modify-info/modify-info",
    "pages/index/view-list/view-list",
    "pages/detail/detail",
    "pages/search_ticket/search_ticket",
    "pages/ticket_detail/ticket_detail",
    "pages/order/order",
    "pages/orderlist/orderlist",
    "pages/my_destination/my_destination"
  ],
  "window": {
    "backgroundTextStyle": "light",
    "navigationBarBackgroundColor": "#fff",
    "navigationBarTitleText": "Wechat",
    "navigationBarTextStyle": "black"
  },
  "tabBar": {
    "position": "bottom",
    "borderStyle": "white",
    "backgroundColor": "#ffffff",
    "list": [
      {
        "pagePath": "pages/index/index",
        "text": "Home",

```

```

        "iconPath": "/images/navbar/home.png",
        "selectedIconPath":
          "/images/navbar/home_active.png"
      },
      {
        "pagePath": "pages/destination/destination",
        "text": "Trip",
        "iconPath": "/images/navbar/destination.png",
        "selectedIconPath":
          "/images/navbar/destination_active.png"
      },
      {
        "pagePath": "pages/find/find",
        "text": "Community",
        "iconPath": "/images/navbar/find.png",
        "selectedIconPath":
          "/images/navbar/find_active.png"
      },
      {
        "pagePath": "pages/personal/personal",
        "text": "My",
        "iconPath": "/images/navbar/my.png",
        "selectedIconPath":
          "/images/navbar/my_active.png"
      }
    ]
  },
  "sitemapLocation": "sitemap.json"
}

```

5. Sum up:

This article takes the "Yu Shang Dao Xiang" mini-program as an example to explore the current status and challenges of rural cultural tourism development, as well as the application and advantages of Wechat mini-programs in rural cultural tourism. As a lightweight and easily spread mobile application, Wechat mini-programs provide solutions for the development of rural cultural tourism, featuring high information dissemination efficiency, good user experience, and ease of promotion. Taking the "Yu Shang Dao Xiang" mini-program as an example, this project is located in Yuhang Street, Yuhang District, with nearly 30,000 mu of basic farmland protection zones. The mini-program offers services such as accommodation, navigation, social interaction, live streaming, direct purchase of local specialties, educational tours, and customized travel experiences, creating a professional, user-friendly, and intelligent platform. This not only enhances the visitor experience and satisfaction but also promotes the integration of agriculture, culture, and tourism, contributing to rural revitalization and shared prosperity.

Overall framework of Yushang Rice Village APP project:

5.1. System Architecture

The system is divided into user layer, application layer, support layer, data access layer and infrastructure layer. Internet of Things, big data, geographic information system and cloud computing technologies are adopted to realize digital and intelligent upgrading.

5.2. Functional Modules

including digital rice field adoption, intelligent navigation system, study service and VLOG application, marketing promotion, management background, etc., to build a digital ecology of agricultural culture and tourism integration through technical means.

System functional module design and implementation:

5.3. System Architecture Design

The system includes four sections: "Home page", "Guide", "Square" and "My", covering functions such as farm mall, leisure and entertainment, boutique homestay, surrounding travel, smart adoption, visit reception, business space, local recommendation and so on.

5.4. Database Design

SQLite database is adopted, including user table, order table, commodity table, shopping cart table, etc., which is used to store user information, transaction order, agricultural products information and shopping cart information.

5.5. Technical Difficulties and Solutions:

Application of data encryption technology: This study uses the MD5 algorithm to encrypt user's personal information, location data and transaction data to ensure data security and prevent information leakage and illegal access.

-Improve response speed: Put the data that users have browsed into the mobile phone cache, and call directly from the cache when they visit again, so as to improve the response speed of the App.

5.6. Outlook

This study demonstrates the application potential of Wechat Mini Programs in rural cultural tourism by designing

and implementing the "Yu Shang Dao Xiang" mini program. It provides detailed analysis and practical guidance for the design and implementation of rural cultural tourism software based on Wechat Mini Programs. Through technical means and platform construction, it enhances the service quality and visitor experience in rural cultural tourism. In the future, we will further optimize system functions, improve user experience, and promote the digital and intelligent development of the rural cultural tourism industry.

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