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Innovative Regeneration of Rural Public Spaces and Community Vitality Enhancement Driven by AIGC Technology: A Case Study of Guojia Ci Public Spaces

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Abstract: In the context of China's ongoing rural revitalization strategy, rural public spaces—critical arenas for community interaction, cultural heritage, and recreation—confront significant challenges, including functional homogeneity and diminished vitality during spatial regeneration. The rapid advancement of Artificial Intelligence Generated Content (AIGC) technologies has unlocked novel methodological avenues for rural spatial regeneration, extending the frontier of design innovation.This study aims to construct and validate an AIGC-assisted design process for rural public spaces. By integrating literature reviews, case studies, and technical evaluations of tools such as Stable Diffusion and Midjourney, a methodological framework was established. Subsequently, using the public space of Guojia Ci Village in Chengdu's Eastern New District as a case study, this framework was applied to a comprehensive practical process—encompassing site analysis, intelligent scheme generation, and community co-creation—to test its application methods and implementation pathways. The study advances three strategic interventions: temporal-spatial resilient layouts, multisensory immersive landscapes, and cultural IP development. These strategies coalesce into a human–machine collaborative design paradigm underpinned by AIGC technologies and oriented toward community participation. The results indicate that AIGC technology can effectively enhance design efficiency and creative diversity, strengthen villagers' sense of participation and belonging in spatial renewal, and promote the contemporary expression and inheritance of local culture.

Keywords: AIGC; Rural Public Space; Community Vitality; Spatial Regeneration; Human-Machine Collaboration.

1. Introduction

Against the backdrop of the ongoing Rural Revitalization Strategy, rural public spaces—as vital venues for villagers' daily interactions, cultural heritage, and leisure activities—are assuming an increasingly prominent role. However, these spaces currently face widespread issues such as outdated facilities, limited functionality, and low utilization rates. Accelerated urbanization and consequent rural out-migration have precipitated vitality attrition and, in extreme cases, the abandonment of public spaces, thereby jeopardizing rural cultural preservation.

Concurrently, AIGC technologies—underpinned by advances in deep learning, natural language processing, and computer vision—are catalyzing paradigm shifts across design disciplines. This technology can automatically generate content such as text, images, audio, and video, significantly enhancing creative efficiency and expanding design possibilities. It has already seen initial applications in architectural, interior, and landscape design, offering a new technological pathway for the renewal of rural spaces.

This study aims to explore the innovative application of AIGC technology in the design of rural public spaces. By leveraging this technology to overcome the limitations of traditional design, this study proposes spatial solutions that are more adaptive, culturally sensitive, and participatory. These solutions aim to optimize functional layouts, enhance environmental quality, revitalize communities, and promote the continuity of rural culture and the strengthening of community cohesion. Theoretically, this study contributes to expanding the theoretical framework for AIGC applications in rural design; practically, it offers actionable technical guidance for the renewal of rural public spaces, thereby supporting rural revitalization and sustainable development.

2. An Overview of AIGC Technology Applications in the Design Field

2.1. The Origins of Generative Architecture

i The evolution from mathematical geometric form generation to algorithmic optimization and performance-based solutions can be divided into three stages

The origins of generative architectural design can be traced back to the 1960s, when it initially relied on methods from discrete mathematics and graph theory (such as Delaunay triangulation and the marching cubes method) to construct simple geometric shapes[37]; With the development of computer graphics, parametric methods (such as NURBS and Bézier surfaces) and variational methods (optimizing geometric shapes via energy functions) gradually emerged, enhancing the complexity and precision of modeling; In the

21st century, deep learning-based geometric modeling algorithms (such as GANs and VAEs) began to be widely applied in the field of architecture. By using neural networks to automatically generate and optimize geometric structures, these algorithms enabled the creation of more complex and realistic shapes. Furthermore, by automatically adjusting parameters based on training data, they improved both the efficiency and accuracy of the algorithms.

ii Classification of Generative Forms

a. Topological Geometry

In architectural design, topological geometry breaks free

from the constraints of traditional, regular forms such as "straight lines and rectangles," enabling buildings to achieve complex curved surfaces and large-span spaces while ensuring structural stability and reducing construction costs.

b. Biomimetic Forms

Biomimetic forms are widely applied in architectural design. By mimicking the forms, structures, and functions of organisms in nature, they achieve a harmonious coexistence between architecture and nature. Specific applications include:

Specific Applications	Features	Case Studies
Biomimicry	By directly mimicking the forms of natural organisms, the architecture evokes rich associations and possesses a unique aesthetic appeal.	The Sydney Opera House, whose design draws inspiration from the graceful curves of a seashell, is a visually striking structure.
Biomimetic Structures	By emulating the structural and mechanical characteristics found in the natural world, we aim to enhance the stability and durability of buildings.	The Beijing Workers' Gymnasium features a double-layer radial cable-stayed structure inspired by a spider web, which allows for a very large span.
Functional biomimicry	Drawing on the functional principles of organisms in nature to optimize building performance.	By mimicking the principles of photosynthesis in plants, solar panels are installed on the building's exterior to make the building energy self-sufficient.
Systems Bionics	By emulating the operational mechanisms and cyclical patterns of natural ecosystems, this approach emphasizes the symbiosis between architecture and the environment.	The Milan Vertical Forest features a large number of trees and plants, simulating the ecological principles of a natural forest. It provides space for plants to grow while improving the microclimate, filtering air pollutants, regulating temperature, and reducing noise.

Figure 1. Specific Applications of Bionic Design

c. Quantifying Building Form Through Physical Performance

The application of quantifying building form through physical performance in architectural design involves the precise analysis and quantification of a building's physical properties to optimize the design and enhance the building's performance and quality. The following are some specific areas of application:

Specific Applications	Features	Case Studies
Optimization of Daylighting Performance	By simulating the physical properties of light as it interacts with the building's form, we optimize window placement and spatial layout to achieve optimal natural lighting.	High-rise office buildings feature zigzag or stepped designs to increase natural light intake and reduce energy consumption.
Improved ventilation	Using technologies such as CFD to simulate airflow, optimize building forms and spaces, promote natural ventilation, and improve air quality.	A team from Shenzhen University has developed a method for evaluating ventilation performance and assisting in design by combining machine learning with Monte Carlo simulation.
Thermal Performance Control	Quantitatively analyze the heat transfer characteristics of building forms; for example, by simulating the thermal conduction and radiation of buildings with different forms across various seasons, we can design structures with excellent thermal insulation or heat retention properties.	During the facade renovation of the Sparkle Building, CFD and thermal radiation simulations were used to analyze the effects of the louver shape and opening angles on thermal control, resulting in the creation of a highly efficient exterior wall system.
Structural Performance Enhancement	Using methods such as finite element analysis, we quantitatively evaluate the distribution of stress and strain in building structures under load, optimize structural configurations and member dimensions, and ensure the structural safety and stability of the building.	A research team from the School of Architecture at Yantai University has pointed out in their study that the discrepancies between virtual design models and physical building structures can be resolved through methods such as the modeling of physical perception and computable physical iteration.
Optimization of Acoustic Performance	In buildings with high acoustic performance requirements, a rational building form and interior spatial layout are designed by quantitatively analyzing the physical properties of the building—such as sound reflection, absorption, and diffusion—to achieve optimal acoustic results.	For example, some concert halls improve sound propagation and distribution by incorporating irregular wall and ceiling shapes, as well as sound-absorbing materials and diffusers, thereby providing the audience with a superior listening experience.

Figure 2. Specific Applications of Quantifying Physical Properties of Shapes

2.2. Technical Characteristics of AIGC Generative Models

Dimension	Midjourney	Stable Diffusion	Invoke	Liblib AI	Point-E	Dreamfields
Technical Principle	Based on Diffusion models, cloud generation	Open-source Diffusion models, local/cloud deployment	Based on Diffusion models, supports canvas extension & editing	Domestically optimized Diffusion model, lightweight	Point cloud generation 3D models	Direct generation of 3D models from text/images
Year of Birth	2022	2022	2023	2023	2022	2021
Hardware Requirements	None (Fully cloud-based)	High (High-end GPU recommended for local)	Medium (Supports cloud and local)	Medium (Cloud-based, lightweight local)	High (Requires GPU for point cloud calculation)	Medium (Cloud computing)
Operational Complexity	Low (Text input via Discord)	Medium-High (Requires learning parameters, plugins, models)	Medium (User-friendly canvas, some learning curve)	Low (Chinese interface, easy to start)	Medium (Requires understanding 3D output formats)	Low (Text/image input, one-click generation)
Customizability	Low (Cannot customize models, controlled by prompts)	High (Trainable custom models, rich plugins/parameters)	Medium (Supports partial control and canvas editing)	Medium (Supports model training, limited options)	Low (Outputs point clouds, small adjustment space)	Low (Models not adjustable, fixed output
Generation Quality	High (Strong artistic style, rich detail, realistic)	High (Controllable detail, high resolution, diverse styles)	High (Natural extensions, good canvas fusion)	Medium (Relies on base models, limited styles)	Medium (3D prototypes usable, average realism)	Low (Suitable for sketches, lacking detail)
Cost	Subscription (10~10~ 60/month)	Free open-source (Requires hardware investment)	Partially paid features (e.g., advanced editing)	Free (Limited attempts, paid value-added services)	Open-source free	Free (Research version)
Advantages	1. Simple operation, high-quality output; 2. Diverse styles, strong artistry; 3. No hardware needed, multi-device access.	1. Free/Open-source, rich ecosystem; 2. Highly customizable, many plugins; 3. Supports local deployment, data security.	1. Powerful canvas features, suitable for extension; 2. Good fusion with existing works; 3. Natural generation.	1. Chinese-friendly, easy to use; 2. Supports model training; 3. Stable domestic access.	1. Fast generation of 3D from 2D; 2. Low 3D modeling threshold; 3. High processing efficiency.	1. No samples needed, direct 3D generation; 2. Simple operation, low entry barrier; 3. Suitable for rapid prototyping.
Disadvantages	1.Relies on hardware needed, multi-device access. precise prompt words. 2.Inability to control structural details. 3.Paid service and slow generation speed. 4.Models cannot be customized.	1.High hardware requirements. 2.Relatively high learning cost. 3.Error-prone in complex scenarios. 4.Style control requires parameter tuning.	1.Inconvenient domestic payment (in China). 2.Functions are dependent on network/internet connectivity. 3.Advanced features require payment.	1.Limited number of free uses. 2.Limited selection of models. 3.Mediocre generation quality.	1.Insufficient realism. 2.Inaccurate conversion understanding. 3.Output is point cloud, making subsequent processing complex.	1.Crude models with poor detail. 2.Extremely low controllability. 3.Only suitable for conceptual design.

Figure 3. Comparison of Mainstream Models

i Definition of AIGC Technology

a. Automated Text Generation

Without the need for humans to create element by element, AI can learn the patterns of training data and generate entirely new content that is both logical and aesthetic based on simple input commands. Examples include DeepSeek, ChatGPT, etc.

b. Images

The core support for image generation comes from Large Language Models (such as the GPT series), Diffusion Models (such as Stable Diffusion), and Generative Adversarial Networks (GANs). These models are trained on massive datasets and possess the ability to understand requirements,

associate information, and create content.

c.3D Models

AIGC covers multiple content forms including text (copywriting, code), visual (images, design drawings), audio (music, voice), and video (short videos, animations), meeting the creative needs of various fields.

ii Comparison of Mainstream Models

In summary, we chose Stable Diffusion. It is free and open-source, with a rich library of models and parameters, allowing the generation of unique images based on individual creativity and needs. High-quality images can be generated through simple text inputs, and it supports various plugin functions with strong controllability, allowing for finer control over various aspects of the generated images through parameter adjustments.

3. Fully Generative Methodological Framework

(1) Model Generation Process

i 2D Images

Utilizing image generation models in AIGC technology, various 2D design drawings such as floor plans, elevations, and renderings are generated based on the design requirements and relevant parameters of the rural public space. These drawings provide designers with initial design concepts and visual representations, helping them better understand the design project.

ii 3D Model Generation

Based on the 2D images, 3D models are automatically generated through 3D modeling algorithms and model conversion tools within AIGC technology. This allows designers to observe and analyze the rural public space from different angles and levels, demonstrating design effects and spatial relationships more intuitively.

iii Floor Plan Slicing

The generated floor plans are sliced and decomposed into multiple regional modules with specific functions and significance. This assists designers in refined design, enabling detailed planning and layout for each module to meet the needs of different users [1].

iiii Regulatory Correction

During the model generation process, AIGC technology automatically checks and corrects the generated design schemes according to relevant design codes and standards, ensuring the rationality and feasibility of the design. Simultaneously, designers can further adjust and perfect the design schemes based on actual cond

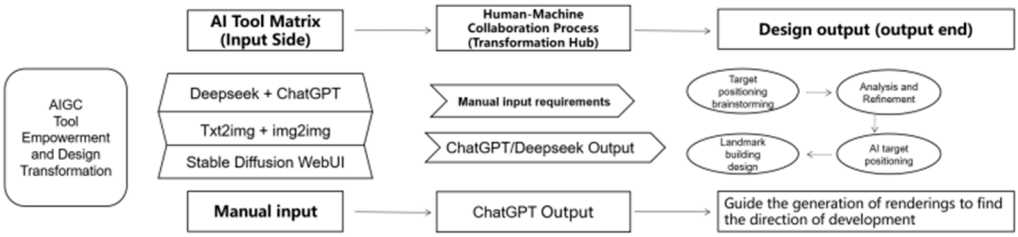


Figure 4. AIGC Tool Empowerment and Design Transformation

iiiii Technical Integration

(a) Data Collection and Organization

Various data collection technologies, such as UAV (Unmanned Aerial Vehicle) mapping, satellite remote sensing, and field investigations, are employed to collect multi-source data including the topography, building distribution, vegetation status, and pedestrian flow of the rural public space [2]. Subsequently, methods such as data cleaning, data fusion, and data standardization are used to organize and pre-process the collected data.

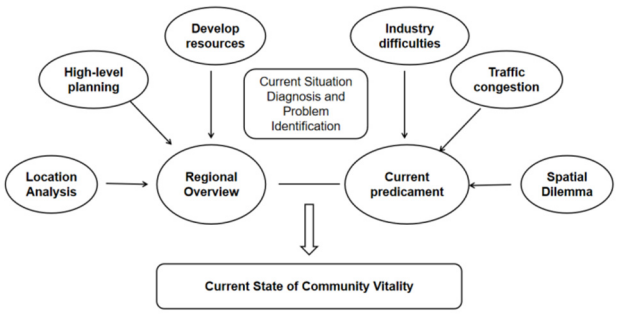


Figure 5. Current Situation Diagnosis and Problem Identification

(b) Generation of Preliminary Design Schemes

Based on the organized data, AIGC models utilize deep learning algorithms and Generative Adversarial Network (GAN) technologies to automatically generate multiple preliminary design schemes. These schemes fully consider the functional requirements, cultural characteristics, and ecological environment of the rural public space, providing designers with a wealth of creative ideas and inspiration.

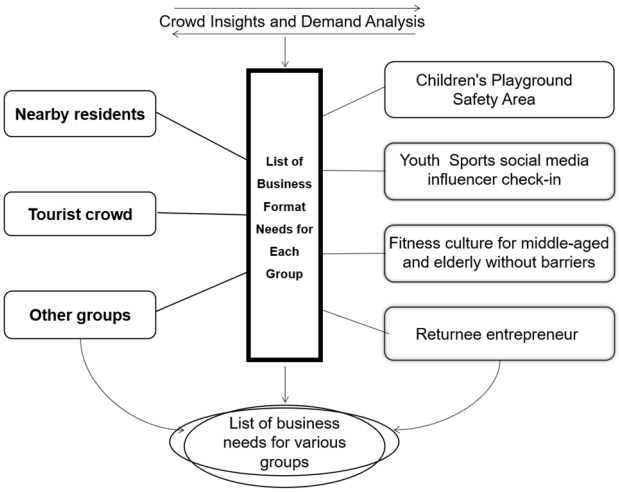


Figure 6. Crowd Insights and Demand Analysis

(c) Scheme Screening and Optimization

Designers screen and evaluate the generated preliminary design schemes based on the design goals and requirements for the rural public space. Optimization algorithms within AIGC technology, such as Genetic Algorithms and Particle Swarm Optimization, are utilized to further optimize and improve the selected schemes, enhancing their quality and

performance [3].

(d) Visualization and Simulation

With the help of Virtual Reality (VR) and Augmented Reality (AR) technologies, the optimized design schemes are presented through realistic visualization and simulation. This allows designers to preview the effect of the rural public space after completion, evaluate the feasibility of the scheme and user experience, and discover and resolve potential problems in a timely manner.

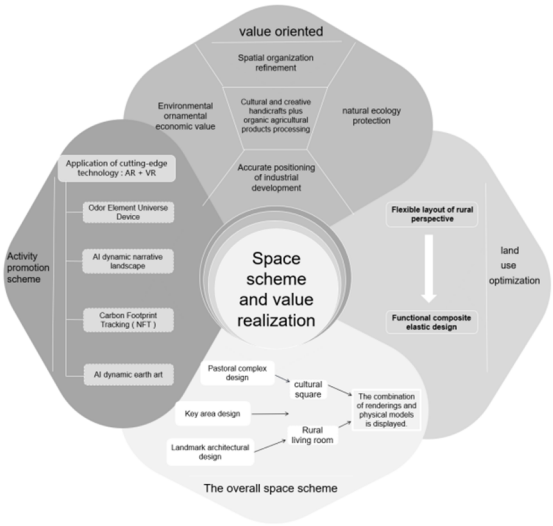


Figure 7. Space scheme and value realization

4. Analysis of the Current Situation of Public Space of Guojiaci in Chengdu

4.1. Regional Overview

Located on the north side of Shipan Street, Guojia Ci lies approximately 40 km from the civic center of Chengdu's Eastern New District, encompassing a territorial area of 5.08 km². It is located at the junction of Longquanshan Urban Forest Park and Jianzhou New City. It belongs to the buffer zone of Longquanshan Urban Forest Park. As a key node in the construction of the two-city economic circle in Chengdu-Chongqing region, the eastern new district of Chengdu has obtained multi-level policy inclination as the key growth pole of Chengdu 's ' 14th Five-Year Plan ' and ' 15th Five-Year Plan '.Macro policies such as ' Master Plan of Territorial Space in the Eastern New District of Chengdu (2021-2035) ' provide top-level guidance for the construction of rural public space, while Guojiaci in Shipan Street accurately fits the ' Master Plan of Longquanshan Urban Forest Park (2016-2035) ' ' Master Plan of Territorial Space in the Eastern New District of Chengdu (2021-2035) ' and the special policy of rural revitalization and urban-rural integration in the eastern new district.



Figure 8. Location analysis of Guojiaci

As an ecological buffer zone of Longquanshan City Forest Park and a village in Chengdu 's one-hour economic circle, the village has convenient transportation, deep integration of agriculture and leisure industry, and public space has multiple functions such as ecological carrying, villagers ' life and tourist service. Its characteristics fully reflect the general law of rural public space in the eastern new district. Therefore, it is selected as the research object, which not only has clear policy support, but also provides reference for the optimization of similar rural public space. It has strong representativeness and research value.



Figure 9. Guojiaci Development Resources Analysis

4.2. Research on the Current Situation of Public Space

i Types of public space

The existing public space type of Guojiaci is relatively single, mainly including the village small square, the surrounding space of the ancestral hall and a small number of community activity venues. The village square is only set up with simple fitness equipment, lack of shading facilities and rest seats, in the sun and rain is difficult to meet the needs of the villagers gathered ; the open space around the ancestral temple is mostly used as a temporary parking space, lacking cultural display and activity organization space ; there is only one activity room less than 100 square meters in the community activity place, and the facilities are obsolete, which can not meet the growing cultural entertainment and social needs of the villagers. From the perspective of space utilization, the existing public space is fragmented and inefficient, and there is a lack of organic connection between the various spaces, which fails to form a coherent public space system. In terms of functionality, the spatial function is out of touch with the actual needs of the villagers, and there is a lack of characteristic functional zoning such as children 's recreation and elderly health care ; in terms of landscape effect, there is a lack of integration of regional cultural elements, the configuration of green plants is monotonous, and the overall visual effect is dull.



Figure 10. Guojiaci public space type distribution map

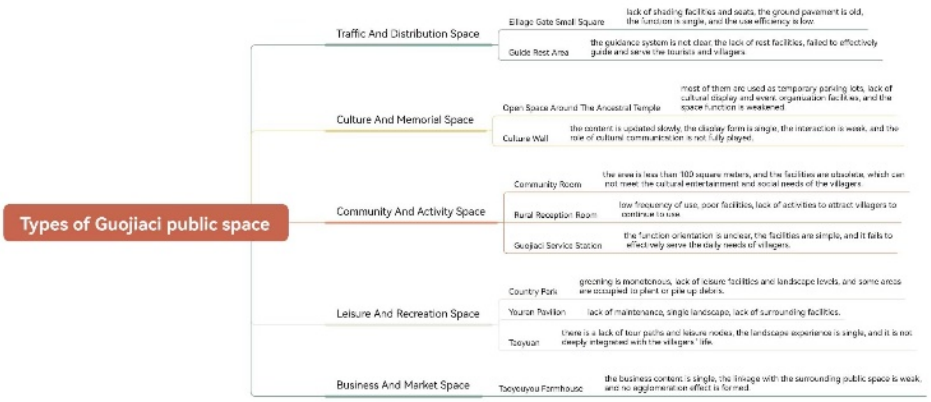


Figure 11. Types of Guojiaci public space

ii Problems

In terms of space utilization : the square space has not been fully utilized. Due to the lack of reasonable functional zoning and facilities layout, the villagers ' activities on the square are relatively single, mainly chatting and basking in the sun, and the use efficiency of the space is low. Inadequate management and planning of green spaces have resulted in the encroachment of certain areas for vegetable cultivation or debris accumulation, thereby compromising the overall landscape integrity.

Functional aspects : the functionality of the existing public space is seriously inadequate. The square lacks shading and rain shelter facilities and cannot be used normally under bad weather conditions. The lack of children 's recreational facilities and fitness equipment for the elderly can not meet the needs of villagers of different ages. The green space is only used as a simple greening area, and there are no supporting facilities such as leisure seats and garbage cans, which can not provide a comfortable leisure environment for villagers.

Landscape effect : the landscape effect of public space is poor. The ground pavement of the square is old, and some areas are damaged and cracked, which affects the beauty and safety of use. The green plants of the green space lack a sense of hierarchy and color matching, the seasonal changes are not obvious, and the landscape is single and boring.

In terms of the use of community residents : due to the above problems in public space, the use frequency of community residents is low. The villagers ' satisfaction with the existing public space is not high, and they are more inclined to carry out activities in their own courtyards or surrounding private spaces. Public space lacks attraction and vitality, and it is difficult to become an important place for villagers to communicate and socialize daily.



Figure 12. Analysis of the current situation of Guojiaci

4.3. Analysis of the Current Situation of Community Vitality

4.3.1. The Status Quo of Community Vitality

Based on the above analysis of the single type of public space and the dilapidated physical environment in Guojiaci, this study further finds that the failure of space ' hardware ' directly restricts the vitality of the community ' software ' dimension, and the two show a clear causal progressive relationship.

At present, the community vitality of Guojiaci is at a low level, which is manifested in the serious imbalance of users. Except for a few traditional festivals and rallies, villagers rarely take the initiative to participate in public activities. In the square, only a few elderly people are chatting here, and young people and children are less involved. The activities of community organizations are often difficult to attract enough residents to participate, and the activities are not effective.

The frequency of public activities is low and the form of activities is single. It is mainly based on traditional activities such as literary performances and sports competitions, lacking innovation and attraction. The time arrangement of the activities is not reasonable enough, which often conflicts with the villagers ' production and living time, resulting in the villagers ' inability to participate.

Due to the low enthusiasm of residents to participate in public activities, community cohesion is weak. There is less communication and interaction between the villagers, and the neighborhood relationship is more indifferent. The community lacks common values and goals, and it is difficult to form strong cohesion and centripetal force.

This kind of social network atrophy and collective sense of

belonging caused by the short board of material space has formed a negative feedback cycle of " space abandonment-energy loss, " which also constitutes the core logical starting point of this study 's subsequent use of AIGC technology to innovate and empower rural space and reshape community centripetal force.

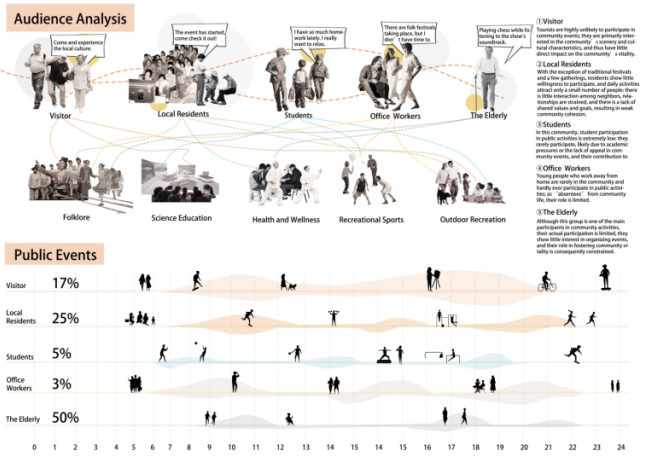


Figure 13. Analysis of the crowd in Guojiaci

4.3.2. Factors Restricting the Improvement of Community Vitality

At present, the overall vitality of Guojiaci community is at a low level. From the perspective of residents ' participation, in addition to the traditional festivals, the number of daily public space activities is scarce, young people are more migrant workers, left-behind residents are mainly the elderly and children, and there is less interaction between residents. Public activities are held less than once a month on average, and the form of activities is single. Most of them are spontaneous chess and card entertainment, lacking collective activities with cultural connotation and attraction. In terms of community cohesion, due to the lack of public space and imperfect functions, residents ' sense of belonging to the community is weak, and neighborhood relations tend to be indifferent.

The factors that restrict the improvement of community vitality are mainly reflected in the following aspects : First, the area of public space is insufficient, and it is difficult to carry diversified community activities ; second, the lack of facilities and old, unable to meet the needs of residents of different ages ; third, the space design is unreasonable, lack of excavation and expression of regional culture, it is difficult to stimulate residents ' sense of identity and enthusiasm for participation.

5. Design Proposal for the Innovative Public Space at the Guo Family Ancestral Hall

Against the backdrop of rural revitalization and cultural confidence, rural public spaces serve not only as the physical setting for daily life but also bear the important mission of preserving local memories and invigorating the community. To this end, the innovative design of the Guo Family Ancestral Hall's public space adopts "Perceiving Rebirth, Cultural Presence, and Community Symbiosis" as its core philosophy, and seeks to reshape the rural public sphere—both materially and spiritually—through a series of multi-layered and systematic intervention strategies.

5.1. Overall Layout Design: Flexible Structure and Multi-functional Integration

The reason rural traditional public spaces often lack sustained vitality stems largely from their overly narrow functional scope and rather limited hours of use; By comparison, the social systems in which humans live are far more complex than ecosystems. When discussing the adaptability required for socioeconomic development, it is particularly important to incorporate resilience research into the discussion, with a focus on the system's capacity for self-organization, coordination, and adaptation driven by a combination of factors—and, in particular, on the system's potential for transformation[4].

Based on this, this study proposes the concept of "temporal flexible layout," which centers on viewing space as a living entity capable of dynamically changing in response to the passage of time, events, and the actual needs of the community. This design breaks free from the limitations of traditional fixed functional zoning; instead, through the deployment of modular facilities and the support of intelligent control systems, it enables the same space to serve as a venue for leisure and social interaction during the day and seamlessly transform into a stage for cultural performances at night. The renewal of rural spaces should emphasize appropriate "open space" and sufficient "flexibility," thereby reserving ample possibilities for spontaneous social life; In the Guo Family Ancestral Hall design, the deliberate variation in floor materials and the introduction of a lighting and projection system serve not only to guide daily functions but also form part of the spatial narrative language. They hint at the transition from ordinary daily life to cultural ceremonial occasions and further enhance the site's own narrative capacity across both temporal and spatial dimensions.



Figure 14. Floor Texture Map



Figure 15. Lighting Projection System

During the day, the space operates primarily as a place to "gather around a stove to brew tea." By arranging movable tables and chairs, lightweight bamboo pergolas, and traditional-style clay stoves, it creates a warm atmosphere conducive to socializing and tea tasting; At night, however, the space undergoes a rapid transformation: a fold-out stage is deployed, retractable awnings are stowed away, and a hidden sound system is activated, turning the area into a tiered open-air theater capable of hosting a wider variety of cultural activities, such as film screenings, traditional opera

performances, or bonfire gatherings. The ground level features an alternating pattern of different materials, such as blue bricks and wooden platforms, combined with lighting projections that clearly delineate each functional zone. Together, these elements ensure a seamless transition between daytime and nighttime settings, preventing potential conflicts between facilities during use while enhancing the overall efficiency of the space and enriching the visitor experience.



Figure 16. Current and Projected Maps

5.2. Landscape Element Design

This landscape design seeks to transcend the realm of traditional visual beautification and instead move toward creating a multi-sensory, integrated ecological experience. The overall design is structured around the concept of "immersion of the five senses," weaving together local plants, materials, soundscapes, and scents into a cohesive environmental narrative. Using AIGC technology, the design team developed a dynamic projection system driven by real-time environmental data such as light, humidity, and foot traffic. Utilizing the Stable Diffusion model, this system generates visual content in real time that corresponds to the current state of plant growth and seasonal changes, projecting it onto vertical green walls to create an ecological wall that appears alive and capable of "breathing." Unlike traditional projection methods with pre-programmed content, AIGC-generated images possess a certain unpredictability and artistic originality. They can automatically adjust the theme and style of the visuals based on the villagers' current activities—such as festive ceremonies or daily gatherings—ultimately achieving an intelligent landscape expression characterized by "one wall, a thousand faces."

This design approach embodies the concept of "sensory restoration," which seeks to strengthen the emotional connection between people and place by reawakening bodily experiences [5]. At the same time, it also reflects how, against the backdrop of the digital revolution, "digital localism" is becoming a reality—technology does not function as some kind of foreign, intrusive element, but rather exists as a medium of cultural translation that is integrated into the local fabric.



Figure 17. A "Breathing" Ecological Wall



Figure 18. AIGC Dynamic Projection

In addition, AIGC is used to generate ambient soundscapes synthesized from authentic local audio samples—such as the sound of wind and birdsong in different seasons, or the sounds of traditional farming tools in use. These auditory designs greatly enrich the sensory dimensions of the space. Elements such as the sound of the wind, folk songs sung in local dialects, and the scents emitted by native plants converge to collectively construct a "rural experience that can be personally encountered," allowing cultural memories to be truly activated through physical perception. This multisensory, immersive design not only carries forward the inherent ecological wisdom of the countryside but also reconstructs the interactive relationship between people, technology, and nature on a new level.



Figure 19. Auditory Immersive Design



Figure 20. Immersive Olfactory Design

5.3. Facility and Functional Design: Community Engagement and Technological Empowerment

In terms of facility design, the proposal focuses on achieving two goals: "community empowerment" and "moderate technological intervention." Facilities such as shared kitchen islands and modular furniture do not merely serve practical functions; they have the potential to become vehicles for inspiring cultural awareness among villagers and fostering innovation and entrepreneurship. By providing a platform for hands-on activities, the design actively encourages villagers to transition from being mere "space users" to active "content creators," as the true vitality of rural spaces is rooted in "daily practices and collaborative community building."

For example, AIGC-generated proposals have shown that placing a shared kitchen island on the northwest side of the site would not only effectively mitigate the negative impact of prevailing winds on cooking fumes but also allow the area to naturally transform into a stage backdrop and service area

at night—a type of cross-functional connection that is typically difficult for traditional linear design thinking to quickly identify; The integration of AIGC transforms spatial planning from a "static arrangement" into a dynamic system that can be predicted and optimized.



Figure 21. Conceptual Design of an Indoor Shared Kitchen Island

The final design of the shared kitchen, the decorative patterns on the surfaces of the modular furniture, and the specific ways in which the interactive installations engage with people all incorporate the results of villagers' direct creative participation using AIGC tools. For example, an elderly villager described a traditional auspicious pattern in the local dialect; after this description was translated and optimized by AIGC, it ultimately became a decorative element incorporated into the paving of the square. This process has tangibly lowered the barrier to professional design participation, returning a portion of the "design authority" to the community itself. As a result, these facilities are not merely products "designed for the villagers," but rather outcomes "designed by the villagers themselves," thereby fundamentally enhancing people's sense of belonging and the vitality of their subsequent use.



Figure 22. Concealed speakers



Figure 23. Solar Panel Design

5.4. Cultural Heritage and Expressive Design: Symbolic Translation and IP Development

In this aspect of cultural expression, AIGC technology has fully demonstrated its outstanding content-generation capabilities and potential for symbolic translation. This study took the region's unique "peach blossom" culture as its core element and, leveraging AIGC, created a cultural IP named "The Peach Blossom Fairy of Guo Family Ancestral Hall," which encompasses character design, backstories, and even the preliminary production of a short narrative animation. The application of AIGC significantly lowers the barrier to cultural creation, facilitating the rapid regeneration and dissemination of traditional elements. This IP character serves not only as a cultural ambassador for the entire village but has also been extended into various formats, including AR exploration activities, picture book storytelling, and a short-video content matrix. This enables local culture to transcend the limitations of physical space, thereby achieving cross-media narrative expression and emotional connection [6].



Figure 24. IP Three-View Drawing



Figure 25. IP Action Extension

5.5. The Comprehensive Impact of Design Strategies on Enhancing Community Vitality

The four design strategies proposed in this chapter are all intended to systematically address and resolve the challenges to community vitality identified earlier; their core logic lies in using innovative design methods enabled by AIGC technology to directly intervene in the "space–behavior–emotion" chain, thereby stimulating the community's inherent dynamism.

5.5.1. Solving the Problem of Inefficient Space Utilization Through Flexible Design

To address the issues of inefficient space utilization and limited functionality, the flexible layout strategy outlined in Section 5.1 is implemented specifically through AIGC-

generated, convertible day-to-night scene designs; Through the introduction of "temporal flexible layout" and modular facilities, the day-to-night scene conversion schemes generated with the assistance of AIGC enable a single site to accommodate a variety of activities, including leisure, gatherings, and performances. This not only directly enhances the actual utilization efficiency and carrying capacity of the physical space but also effectively resolves the conflict between spatial underutilization and mismatched demand, while simultaneously establishing a solid physical foundation for fostering community vitality.

5.5.2. Revitalizing Underutilized Landmarks Through Immersive Experiences

To address the issue of a monotonous landscape, the five-sense immersion strategy outlined in Section 5.2 utilizes AIGC-assisted ecological wall imagery, localized soundscapes, and scent design schemes to collectively transform the public space into a venue for immersive experiences and sensory engagement; This multisensory stimulation significantly enhances the space's appeal and emotional resonance, encouraging villagers to linger, explore, and interact more spontaneously, thereby effectively transforming foot traffic into a sustained source of vitality.

5.5.3. Empowering Community Cohesion Through Participation

To address the issue of low resident participation, the participatory facilities and AIGC co-creation tools discussed in Section 5.3 directly confront the reality of low resident engagement. By focusing on strengthening a sense of community belonging and resident agency, they lay a sustainable foundation at the societal level; Building on practical facilities such as shared kitchens and modular furniture, and combining them with AIGC as a low-threshold co-creation tool, the design process itself is transformed into a community mobilization effort. Villagers evolve from passive users of space into active participants and builders. This empowerment process significantly strengthens residents' sense of belonging, their sense of agency, and social bonds among neighbors, while also injecting deep social capital into the sustainability of community vitality.

5.5.4. Enriching the Substance of Events Through Cultural IP

To address the issue of monotonous event formats, the cultural IP strategy outlined in Section 5.4 offers a solution to this challenge. By leveraging the AIGC-generated "Peach Blossom Fairy" IP and its derivative narrative content, the strategy infuses community events with a core theme that combines cultural identity with modern appeal; Activities centered around this IP—such as AR scavenger hunts and the development of cultural and creative products—have created novel forms of public engagement and cultural consumption scenarios. These are particularly appealing to the younger generation, organically combining cultural heritage with community entertainment and thereby ensuring the sustained vitality of the initiative over time.

6. Conclusion

Once AIGC technology is integrated into the process of revitalizing rural public spaces, its significance extends beyond the "improved efficiency" that can be achieved at the tool level; it can also be viewed as the embodiment of an entirely new paradigm of spatial production—one that represents a deep integration of technology, culture, and human-centered values; In the specific case of the Guo Family Ancestral Hall, AIGC technology has facilitated multifaceted transformations: the space has shifted from a static state to one with responsiveness; culture has evolved from mere preservation to regeneration; and the community's role has transformed from passive participation to active leadership, thereby establishing a form of rural publicness characterized by the digital age. To enhance rural vitality, efforts must go beyond merely beautifying the physical environment; they must extend to reshaping social relationships and comprehensively reconstructing the cultural ecosystem. Through the systematic integration of flexible layouts, sensory design, community empowerment, and cultural translation, public spaces can become a medium of communication connecting the past and the future, individuals and communities, and the local and the global. Future research could further explore specific mechanisms for operation and maintenance, ways to ensure the long-term sustainability of community participation, and the appropriate application of digital technologies. The aim is to facilitate the transformation of rural public spaces from "design objects" to "governance platforms," thereby providing a sustainable pathway for advancing the rural revitalization strategy.

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