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Constructing Immersive Experiences: Creative Practices of Virtual Painting in Depicting Hakka Walled Village Scenes

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Abstract

Hakka walled villages of southern Jiangxi are a vital component of traditional Chinese residential architecture and hold a significant position in Hakka culture. However, the number of these structures has plummeted from nearly 1,000 in the early years of the People's Republic of China to fewer than 700 today, necessitating an increasingly urgent conservation effort. As the value of traditional Chinese culture grows, the effective preservation and revitalization of the Hakka walled house culture of southern Jiangxi has become a key research topic. This study analyzes the artistic characteristics of walled house architecture and folk culture, exploring the spiritual and aesthetic values, underlying them and extracting cultural symbols from both architecture and folk customs. Leveraging the immersive painting tool Tilt Brush within virtual reality technology, the study explores artistic forms and creative methods within a virtual environment, enhancing the appeal of walled house art and identifying the intersection between traditional architectural culture and modern artistic creation. The resulting work results in four immersive virtual environments. The research showcases the artistic characteristics of walled house culture, leveraging the interactivity and immersive Ness of virtual art to enhance cultural communication. The study aims to present expressive and contemporary artworks in relevant exhibitions, walled house-themed museums, and other platforms. The study also explores the value of virtual painting in the digital preservation of traditional culture, ultimately contributing to the promotion and preservation of walled house culture.

Keywords: Hakka People in Southern Jiangxi, Culture of Hakka Walled Villages, Virtual Reality Painting

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Introduction

Southern Jiangxi's Hakka walled villages are a key type of Chinese traditional residential architecture, mainly distributed in Ganzhou's southern counties (Longnan, Quinan, An yuan, Xuanwu). Longnan preserves over 370 compounds (prominently square "fang weiwu") with well-preserved styles (Wan, 1996). As multifunctional spaces integrating residence, defense, religion and community, they embody Hakka's spatial wisdom and cultural identity shaped by migration (Zhou, 2012).

In 1999-2000, Tokyo University of the Arts' Keiichiro Moribayashi and Kazutoshi Katayama led Sino-Japanese teams to survey southern Jiangxi. They noted the large-scale walled villages integrate multiple functions around a central plaza, forming rare monumental vernacular architecture. "To see a walled village is like reading an architecture textbook," they commented, while Waseda University's Yamamoto called them "ancient Rome's Eastern counterpart—a architectural miracle," highlighting their unique complexity and scale.

Recent local government preservation efforts (data collection, training, tourism investment) boosted awareness but are superficial. Digital art uses 3D modeling (Blender, 3ds Max) or drone scanning, but such tools prioritize precision over emotion; laser scanning/BIM focus on realism, leading to static experiences and high costs. Virtual painting, with 3D and interactivity, offers new solutions by conveying cultural spirit via artistic translation.

This study takes Hakka walled villages as a case, integrating symbol extraction, technical application and immersive design. It creates four thematic virtual scenes ("Inheritance," "Stability," "Celebration," "Watchfulness"), providing references for traditional culture's digital representation.

Research Objectives

1. To investigate and analyze the symbolic features of Hakka walled villages and folk culture in southern Jiangxi.
2. To study the characteristics and creative methods of virtual painting art.
3. To create virtual painting works that reflect the characteristics of walled house culture.

Literature review

1. Studies on Hakka Walled Village Culture

Hakka walled villages, a distinctive form of traditional residential architecture in southern Jiangxi, encapsulate profound clan-based cultural traditions and spatial symbolism. Scholars have approached these structures from various disciplinary angles—including architecture, anthropology, and folklore—to examine their defensive features, spatial configurations, and cultural functions (Zhong, 2013). Beyond serving as dwellings, walled villages function as central arenas for collective identity and ritual practice (Liu, 2003). More recent scholarship has shifted toward analyzing their symbolic dimensions and the ways in which these cultural forms are reinterpreted and disseminated in contemporary contexts (Lei Shuhua, 2018).

2. Virtual Painting and Digital Cultural Expression

With the advancement of virtual reality technologies, virtual painting has

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emerged as a novel medium for digital art and cultural heritage preservation. Research in this area focuses on the technical affordances and expressive potential of VR painting tools such as Tilt Brush, highlighting their capacity for spatial reconstruction and immersive engagement (Sun, 2021; Xiu, 2017). Virtual painting not only enriches the visual representation of traditional architecture but also opens new avenues for cultural transmission. Some scholars have further explored the challenges of authenticity in digital reproduction and the complexities of cross-cultural terminology translation (Sun, 2017; Wang, 2015).

3.Synthesis and Future Directions

The digital study of Hakka walled villages occupies a dynamic interdisciplinary frontier, integrating architectural and cultural analysis with technological and artistic innovation. Future research may delve deeper into the cognitive impact of immersive experiences and promote the internationalization of creative frameworks, thereby contributing to the global appreciation and dissemination of traditional Chinese architectural heritage.

Research Methodology

This study adopted literature research, field investigations, interdisciplinary research and practical research, following the process "theoretical framework symbol extraction practical creation effect evaluation." The "semiotics + architectural symbolism" framework provides systematic support for exploring Hakka walled village cultural symbols' artistic expression in VR.

Literature research (Wan Younan, Luo Xianglin et al.) initially classified walled house symbols: architectural (square outlines, ancestral halls, watchtowers), folk behavioral (ancestor worship, fire dragon dances) and spatial symbolism, laying theoretical groundwork.

Field investigations in Wushiwei, Yanyiwei and Guanxi Xinwei, with interviews of locals, preservationists and experts, supplemented literature gaps and ensured symbol accuracy.

Interdisciplinary research integrated architecture (spatial layout), folklore (ritual interpretation) and semiotics ("signifier-signified" theory) to deconstruct symbols' form and connotation, proposing culture-conducive creation forms.

Practical research focused on Tilt Brush: exploring brush characteristics, force control and spatial expression to optimize traditional culture's visual representation. It verified symbol visualizability and developed a virtual painting method for walled villages.

In summary, this research establishes a dynamic interplay between theory and practice, aiming to integrate cultural understanding, artistic expression, and technological innovation. It seeks to advance the digital preservation and global appreciation of Hakka architectural heritage through immersive and culturally sensitive visual storytelling (Figure 1).

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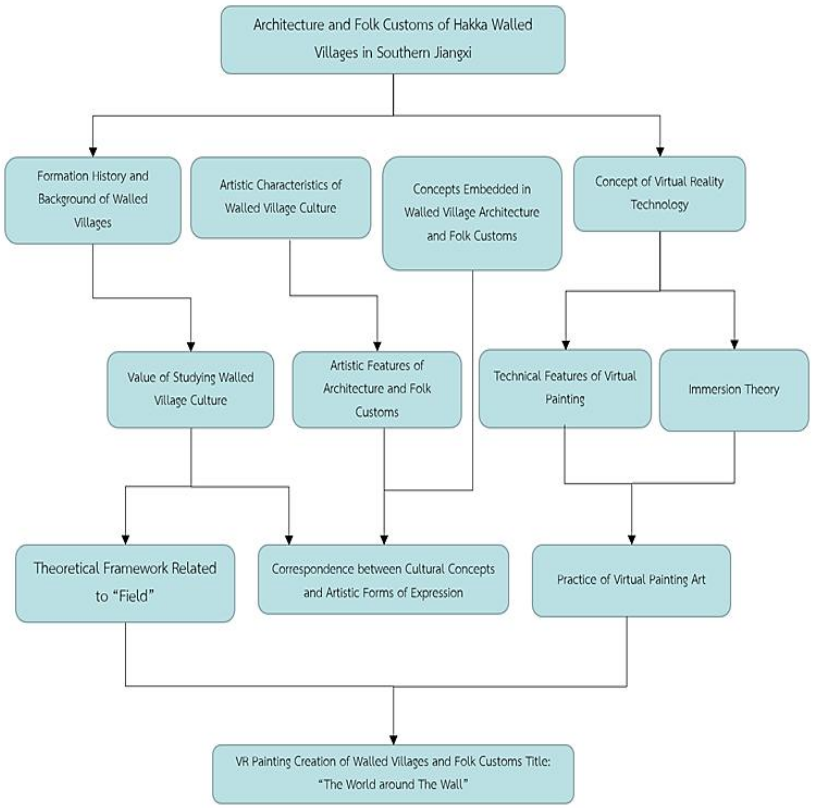

Figure 1 Conceptual Framework (Source: Constructed by researchers)

Research results

1. Symbolic Features of Walled Village Scenes

The immersive construction of walled village scenes must be anchored in cultural symbolism. Through field investigation and literature analysis, core elements are extracted from architecture and folk traditions to serve as symbolic foundations for creating a culturally resonant sense of place.

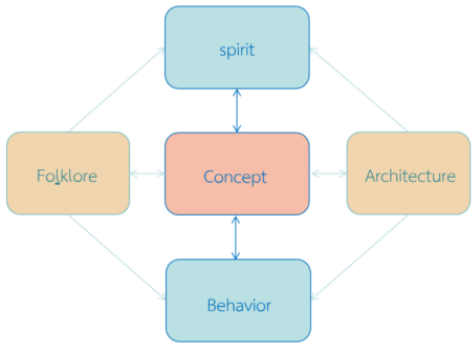

Figure 2 Spatial Field Relationship Diagram (Source: Constructed by researchers)

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1.1 Architectural Symbols: Visual Carriers of Spatial Order

The architectural form of the walled village itself is a “readable” cultural text. Symbol extraction must consider both formal characteristics and conceptual meanings:

Square Layout: Symbol of Safety and Stability The primary function of the walled village is residential, designed to ensure secure living in complex external environments. This “residence” encompasses defense, communal living, and clan cohesion. The square form, being efficient and compact, best fulfills these needs, making it the dominant typology in southern Jiangxi Hakka architecture.

Table 1 On-site visits and research

Type	visit photos	field research
1.Gongzi-shaped Walled House: Guanxi New Walled House Built in the third year of the Jiaqing reign of the Qing Dynasty (2341 B.A.) and completed in the seventh year of the Daoguang reign (2370 B.A.).		The most complete enclosure: The axis runs from the center of the east wall, along the small garden, through the hall, and to the center of the west wall. The building is three stories high and 7 meters high;there are watchtowers at each corner.
2. U-shaped walled house: Yaxi Walled House Built in the seventh year of the Shunzhi reign of the Qing Dynasty (2193 B.E.) and completed in the 16th year of the Kangxi reign (2220 B.E.)		The most exquisite walled house: From west to east, the central axis extends from the entrance hall into the ancestral hall, with a vertical layout that is symmetrical on both sides; The building has four stories and is 14.3 meters high; There are watchtowers at the northwest and southeast corners, both reaching the same height as the fourth floor of the walled house.
3. Hui-shaped walled house: Wushiwei Built in the 10th year of the Wanli reign of the Ming Dynasty (2125 B.A.) and completed in the 38th year of the Wanli reign (2153 B.A.).		The walled house with the most obvious clan identity: The walled house has a distinct axis. It occupies a large area, has a rich spatial hierarchy, and has many open spaces such as courtyards. The layout utilizes two semicircular arcs to accommodate the pond in front of the walled house and the "Huatai" (transformation of the body) at the back, creating a "round sky and square earth" shape. The third floor of the walled house

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Type	visit photos	field research
		serves as a watchtower, and there are five of them.

Axial Symmetry: Reflection of Hierarchical Order The centripetal and symmetrical layout—such as clan halls at the center and courtyard alignment along the central axis—materializes the clan-based worldview. The ancestral hall, as the core symbol, occupies an irreplaceable spatial position and features superior scale and ornamentation (e.g., tall timber frames, elaborate carvings), directly corresponding to Confucian values of ancestor worship and social hierarchy.

1.2 Folk Symbols: Emotional Anchors of Dynamic Narratives

Folk rituals represent the “living culture” of the walled village. Symbol extraction focuses on the interaction between people and symbolic objects:

Rituals: Constructing a Symbolic System of Spiritual Connection Clan-based ancestral worship transforms abstract beliefs into tangible symbolic systems through coherent behavioral practices. These rituals are not isolated acts but are shaped by human participation, material use, and spatial context, forming a spiritually charged environment.

Feng Shui Practices: Embodied Symbolism of Auspicious Action Feng Shui rituals translate abstract beliefs of fortune and protection into concrete, perceptible actions. Like spatial concepts in architecture, these practices involve continuous participation and multidimensional interaction, forming a coherent symbolic system.

Fire: A Dynamic Symbol of Function and Spirit Fire serves both practical and symbolic roles in Hakka folk culture. Functionally, firelight provided warmth and protection—beacon fires lit atop corner towers formed a defensive alert system, while hearth flames symbolized domestic continuity. Spiritually, fire’s unpredictability was ritualized to maintain order, such as in celebratory events where incense dragons danced through the village, animating the space with symbolic energy.

2. Technical Characteristics of Virtual Painting

2.1 Core Dimensions of Immersive Experience

Immersion refers to the participant’s sense of presence within a virtual environment. The concept draws from Mihaly Csikszentmihalyi’s theory of “flow,” where a balance between challenge and skill leads to deep engagement. The immersive process unfolds in three stages (Figure 3):

Initial stage: goal-setting and immediate feedback establish interaction

Middle stage: focused attention deepens engagement

Final stage: temporary suspension of real-world awareness, achieving full immersion

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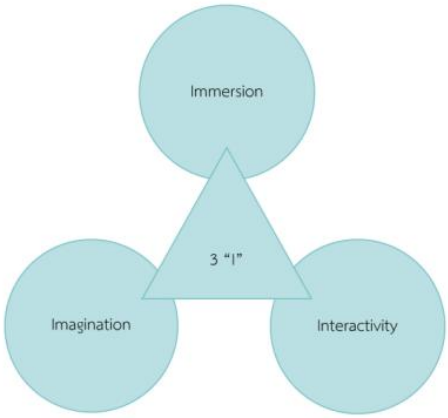

Figure 3 Conditions for Immersive Experience (Source: Constructed by researchers)

Virtual painting can be analyzed through immersion theory, which reveals its multidimensional structure involving cognitive, emotional, and behavioral components:

Cognitive immersion enables viewers to understand the ethical and defensive logic of walled village architecture.

Emotional immersion evokes cultural resonance through folk symbols.

Behavioral immersion allows viewers to explore space through shifting perspectives.

This layered experience reflects virtual painting's unique capacity to integrate space, symbolism, and interaction.

2.2 Technical Adaptability of Virtual Painting

Virtual painting is a creative form that uses computers and VR devices to allow artists to "enter" a three-dimensional space and paint. Originating in the 1990s, the technology has evolved into lightweight, wireless headsets that enable immediate immersion. With tools like Tilt Brush, creators can engage in spatial painting, expanding the boundaries of artistic expression. With the continuous advancement of technology, the device uses the Chinese-developed PICO 4 glasses, a new VR product from ByteDance. Equipped with a Qualcomm Snapdragon XR2 processor, it was officially released on September 27, 2022. PICO 4 provides users with a rich content experience, including VR sports and fitness, VR video, VR entertainment, and VR creation. It supports eye tracking and facial tracking technology, and features intelligent stepless interpupillary distance adjustment, real-life expression simulation, eye contact interaction, and eye contact tracking rendering. Open Brush outputs scene files in TILT/OBR/PNG format, enabling switching between different virtual painting platforms.

Tools such as Tilt Brush and its open-source counterpart Open Brush offer key advantages in three-dimensional storytelling and real-time interaction, aligning well with the immersive needs of walled village scenes:

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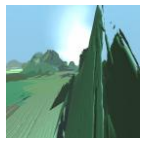
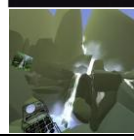
Table 2 Comparison of Tilt Brush stroke characteristics

Virtual brushstrokes	Virtual painting art practice	Depicted objects or themes
Oil brush		Use color and light and shadow to create realistic volume, just like in traditional painting. Apply lighting effects to models, similar to 3D design software, to imbue virtual figures with realistic textures.
Light brush Plasma brush		Brushes with varying thickness and color value create optical fiber-like variations.
Fire brush Embers brush		Dynamic brushstrokes with flame-like characteristics enhance the atmosphere of festive fireworks displays around houses.
Smoke brush		Authentic fog effects create an atmospheric atmosphere and a sense of space.
Snow brush		Some brushes have pre-set common shapes, adding expressiveness and impact.
Special brush		Some brushes have pre-set common shapes, adding expressiveness and impact.

Spatial Freedom: Unlike traditional static or linear imagery, virtual painting incorporates kinesthetic engagement, sensory perception, and cognitive interaction. It enables cultural expression to become spatial, contextual, and interactive. Viewers are transformed into inspired participants and co-creators, reshaping the act of viewing into an embodied experience.

Expressive Brushwork: Many brush settings in virtual painting draw from traditional art textures—such as oil painting or wash effects. Compared to the fixed perspective of 2D painting or the realism of 3D modeling, virtual painting's expressive brushwork and dynamic narration better convey the spiritual essence of walled village culture. It preserves the "freehand" aesthetics of Eastern art while inviting viewers to shift from passive observation to active exploration.

Interaction and Camera Dynamics: In Tilt Brush, creators can predefine camera paths to guide spatial design in stages. Although current device capabilities are limited, built-in camera motions—such as diving, orbiting, or panning—can lead viewers through ritualistic sequences (e.g., corridor—courtyard—ancestral hall) or environmental transitions (e.g., mountain—village —walled compound), enhancing narrative immersion.

3. Creative Practice and Immersive Design in Virtual Painting of Walled Village Scenes

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Based on the symbolic and technical features discussed above, this project develops four narrative scenes—Inheritance, Stability, Celebration, and Watchfulness—each designed to evoke immersion through spatial composition, brushwork selection, and camera choreography. The total duration of the virtual painting is 4 minutes and 19 seconds.

3.1 Scene One: Inheritance (0–59 seconds) — Constructing the Solemnity of Ancestral Rituals

The subject of this scene is the ancestral hall. Immersion is achieved through three layers of camera movement:

Macro narrative: The camera guides the viewer from the dim corridor and open courtyard into the ancestral hall, gradually focusing on the central altar, establishing a spatial framework that reflects ritual progression.

Meso narrative: Through dynamic scene transitions, architectural layering, and atmospheric modulation of form and color, the solemnity of clan rituals is emphasized. Realistic lighting and shadow deepen the sense of reverence.

Micro narrative: Symbolic details—materials, props, and spatial textures—are used to generate rich visual associations. These elements invite viewers to discover and interpret the cultural nuances embedded in the ancestral architecture.

Together, these three narrative dimensions reflect the Hakka clan values of “tracing origins – gathering kin – honoring ancestors.”

Table 3 Storyboard of Scene One (0–59 seconds)

Time	Shot Type	Visual Content Description	Camera Movement Description
0”-5”	Medium-close shot		The camera slowly advances from the entrance of the courtyard toward the center of the ancestral hall, revealing the sloped roof structure and drainage outlets.
6”-9”	Medium-close shot		The camera captures the entrance into the ancestral hall from a different angle.
10”-12”	Close-up		The camera focuses on the carved details, slowly pushing in to emphasize craftsmanship.
13”-16”	Wide & Medium shot		The camera pans horizontally from the lower hall to the middle hall, with a slight upward tilt. Another angle reveals the architectural features of the ancestral hall.

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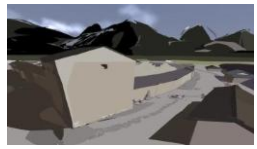
Time	Shot Type	Visual Content Description	Camera Movement Description
17”-25” 26”-28”	Close-up & Detail Close-up & Detail		The camera moves laterally from the door plaque toward the altar, then pushes in for a close-up of the tabletop.
0”-5”	Medium-close shot		The camera slowly lifts from the offering table, transitioning into the painting behind it, opening the narrative for the next scene.

3.2 Scene Two: Stability (60–166 seconds) — The Symbiosis of Landscape and Walled Villages

This scene depicts Hakka villages nestled within natural landscapes. Drawing inspiration from traditional Chinese landscape aesthetics, the composition employs techniques such as “high vantage points, distant perspectives, and multiple viewpoints.”

The camera descends gradually from lofty mountains and rivers to lower terrain, transitioning from distant to near views. As it moves through clouds, valleys, and riverbanks, the geographic context of Hakka settlements unfolds. The scene then shifts to distant villages, foreground trees, and fences, revealing symbolic features of walled village culture layer by layer—like an unfolding scroll that immerses the viewer in the atmosphere of southern Jiangxi’s Hakka heritage.

Table 4 Storyboard of Scene Two (60–166 seconds)

Time	Shot Type	Visual Content Description	Camera Movement Description
29"–33"	Long shot		The camera dives through the clouds in a plunging motion, revealing the vast landscape.
34"–50"	Medium-long shot		The camera moves horizontally, following the direction of a winding path.
51"–60"	Wide shot		The camera rotates around the village, emphasizing the central position of the walled compound.
61"–82"	Medium shot		The camera advances from the front to the side of the walled house, revealing its defensive structure.

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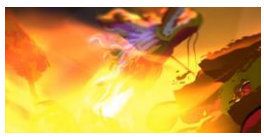
Time	Shot Type	Visual Content Description	Camera Movement Description
83"–100"	Close-up		The camera glides along the sloped roof tiles, following their incline.
101"–116"	Detail shot		The camera peers through an opening from the outside, offering a glimpse into the interior.
117"–133"	Wide shot		The camera pulls back from the fields, integrating both people and the walled village into a unified frame.

3.3 Scene Three: Celebration (167–233 seconds) — Emotional Resonance of Folk Rituals

This scene focuses on folk rituals within the walled village environment, emphasizing emotional expression and cultural transmission. Rather than using realistic representation, the scene adopts a cubist approach to deconstruct various elements of Hakka culture—architecture, figures, and landscape—seeking a fusion of mood and meaning rather than literal form.

By breaking the boundaries of time and space, the scene evokes the emotional depth of Hakka folk traditions within the symbolic context of the walled village.

Table 5 Storyboard of Scene Three (167–233 seconds)

Time	Shot Type	Visual Content Description	Camera Movement Description
167”-171”	Wide shot	 	Rapid transitions between multiple perspectives—bird’s-eye view, low-angle shot, and lateral movement.

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Time	Shot Type	Visual Content Description	Camera Movement Description
172”-200”	Alternating medium & close shots		The camera weaves through the fire dragon, alternating between virtual and expressive brushstrokes.
201”-234”	Dynamic camera motion		The camera follows the dragon’s path, rotating and leaping between architectural structures.
235”-241”	Close-up + Wide shot		The camera lifts from a close-up of fireworks to a wide view, layering virtual and real elements.

3.4 Scene Four: Watchfulness (234–259 seconds) — A Sense of Historical Transition

This final scene portrays the alleyways of the walled village and an elderly Hakka guardian. Using cinematic techniques, the scene reflects the gradual disappearance of walled village culture. The fading visuals suggest that folk traditions are vanishing even faster than the architecture itself.

The sequence of visual disappearance implies a poignant reality: the decline of intangible cultural heritage precedes the loss of physical structures.

Table 6 Storyboard of Scene Four (234–259 seconds)

Time	Shot Type	Visual Content Description	Camera Movement Description
242”-247”	Medium shot		The camera slowly advances forward as mist gradually thickens.
248”-252”	Close-up		The camera focuses on the elder’s face, with subtle handheld motion.
253”-259”	Long shot		The camera pulls back as the mist fully envelops the frame.

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Figure 4 Video of the creative process QR code (Source: Constructed by researchers)

4. Result Analysis

4.1 Analysis of Hakka Walled Village Architectural Culture

Virtual painting not only preserves the authenticity of Hakka walled village culture—such as the visual recognition of explicit symbols and the transmission of deeper conceptual values—but also endows it with expressive power suited to the digital age. As traditional culture becomes "seen, engaged with, and reinterpreted," it transcends geographic and formal boundaries, retains ethnic identity in cross-cultural dialogue, and gains renewed vitality amid modern challenges. As a contemporary medium, virtual painting allows traditional culture to truly "live" in the present, serving as a dynamic bridge between past and future in the context of globalization and digital transformation.

4.2 Analysis of Virtual Painting Techniques and Effects

Taking Tilt Brush as the primary tool in this study, its brushstroke functions are diverse and flexible, yet limitations remain in rendering fine details and achieving smooth tonal transitions—making it difficult to attain the "refinement" typical of traditional art. Control over stroke angles and continuity is still underdeveloped, hindering the depiction of complex structures. The later release of Open Brush introduced improvements in spatial positioning, allowing adjustments along the X, Y, and Z axes. However, the tool still lacks the fluidity needed for smooth surface rendering. These constraints prompted this study to embrace a "productive deviation" approach, leading to the development of a unique artistic language and expressive method tailored to virtual media.

4.3 Analysis of Immersive Cultural Scene Reconstruction

Virtual painting breaks away from the static and linear nature of traditional image dissemination by integrating kinesthetic engagement and cognitive interaction, enabling cultural expression to become more three-dimensional and participatory. Within the virtual walled village, viewers are no longer passive observers but active participants and co-creators, with their viewing habits redefined. Through the reconfiguration of figurative symbols, Hakka identity shifts from "cultural memory" to a perceptible "visual totem." The work transcends mere architectural imitation, instead reconstructing space through mobile viewpoints and interactivity. Visual cues—such as directional lines, color contrasts, and light-shadow dynamics—guide viewers through immersive journeys, ultimately converging on the central theme of "Hakka cultural wisdom and clan ethics."

4.4 Application of Virtual Painting Scenes

Using Tilt Brush, virtual paintings of Hakka walled houses in southern Jiangxi reflect the artist's unique understanding and stylized expression of the

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walled houses, creating differentiated experiences in multiple fields:

In education, personalized brushstroke experiences can be used. For example, learners can use the different effects of brushstroke tools to experience the weight of rammed earth walls and the dynamic landscape of southern Jiangxi. This allows for different creators to interpret the cultural characteristics of the walled houses, enabling learners to translate their emotional understanding into brush language and cultivate "culture + expression" skills.

In museum exhibitions, the works can serve as a "narrative supplement from the creator's perspective," offering diverse interpretations through stylized presentation. Digital archives serve as living specimens of the walled houses, unique records of the creator's cultural understanding, and poetic expressions. This allows viewers to experience not only the architecture but also the artist's artistic conception of the walled houses, attracting attention while reducing excessive consumption of the walls.

Discussion

This study centers on Hakka walled villages and employs virtual reality painting to construct an immersive cultural narrative, breaking away from the static presentation typical of conventional digital modeling. Compared to reconstruction-focused projects—such as Wang Zhiqiang & Wang Youjian (2016), which emphasize architectural form restoration—this research prioritizes the integration of cultural symbolism and spatial experience. Through the design of cinematic scripts and control of brushstroke rhythms, it achieves a dynamic interplay between architectural space and folk rituals, allowing viewers to engage emotionally within the virtual environment. The study responds to the concept of “affective immersion” proposed by Bai Heting & Shao Jun (2021), emphasizing that digital media serve not only as tools of representation but also as active participants in cultural expression. The layering of virtual and physical elements, along with rhythmic variations, enhances visual depth and evokes cultural resonance. Moreover, the expressive qualities of Tilt Brush offer new dimensions for spatial storytelling, transforming architecture from a static object into a cultural field that can be “walked through” and “touched.”

Bridging digital humanities and immersive art, this research proposes a context-sensitive, participatory model for traditional architectural culture's digital dissemination. Using walled houses as a cultural medium, it conveyed Chinese freehand landscape painting's creative freedom via virtual painting yet exposed key limitations.

1. Research Design Limitations: To ease viewer pressure, cultural interpretations were simplified, causing cognitive biases—viewers appreciated rammed earth brush textures but missed "clan cohesion" in "Four Waters Converging to the Hall" layout, and misread folklore as decorations. No control group (e.g., non-brush virtual experiences) prevented quantifying "brush spirit" effects on artistic sensibility, weakening conclusions.

2. Technical Limitations: Open Brush default tools failed to replicate traditional painting textures—only basic pressure-based thickness adjustment, lacking "flying white" and "dry brushstrokes," resulting in "digital color blocks." 3D "white space" appeared empty (e.g., walled house background seemed unfinished), deviating from painting spirit.

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3. Creative Practice Challenges: 2D landscape "conception logic" clashed with 3D: free perspective made viewers overfocus on side landscapes, neglecting the walled house; overstated dynamic brushstrokes (e.g., fire dragon) diverted focus from artistic conception, as one noted, "The fire dragon looked beautiful, but I forgot the walled house's brushwork."

4. User Experience Limitations: Pico Neo3's complex controllers hindered basic interactions, failing to "liberate natural experience." Feedback relied solely on random interviews, lacking systematic tools (e.g., emotional scales), unable to quantify "artistic sensibility liberation" effects.

This study utilizes virtual reality painting as a medium to construct a digital narrative system that integrates architectural space, folk rituals, and immersive experience. Through cinematic scripting and brushstroke design, it enables dynamic expression of Hakka cultural heritage, enhancing emotional engagement and cultural resonance among viewers. Key contributions include: proposing a spatial storytelling method based on immersive painting, expanding the expressive possibilities of traditional culture in digital contexts; reinforcing the situational and interactive nature of virtual dissemination; and providing a practical artistic framework for the digital preservation and communication of Hakka walled villages and other traditional architectures.

Future research may extend to broader immersive scenarios, promoting the revitalization and regeneration of traditional culture within new media environments.

Recommendations

1. Theoretical Recommendations

To address superficial theoretical integration and insufficient practical support, future research could combine Merleau-Ponty's body phenomenology with spatial narrative theory. Analyzing experiencers' "body interaction" phenomenologically would enable constructing a "three-dimensional virtual painting aesthetic" framework.

1. Existing Theory Limitations: Current research directly applies 2D landscape aesthetic theories (e.g., Xie He's "Six Principles," Guo Xi's "Three Distances") to virtual creation, ignoring 3D space's unique properties: Virtual "perspective freedom" breaks traditional fixed-perspective "primary-supporting scene" logic (e.g., users may neglect the enclosure's brushwork); 2D "white space"—relying on planar tension—easily appears empty in 3D (e.g., enclosure background seems "unfinished"); no dedicated theory explains "3D brushstroke-perspective interaction-conception transmission," causing disconnection between "freehand conception" and "perception."

2. Research Gaps: Gap 1: Specific rules for translating 2D aesthetics (e.g., "artistic conception," "white space") to 3D, especially theoretical support for conception focus in "free perspective." Gap 2: Lack of bodily phenomenological explanation for the link between "physical interaction (touching, walking)" and "spiritual perception" in virtual painting.

These supplements address current theoretical shortages and provide a feasible path for researching "virtual painting conveying painting spirit and liberating artistic sensibility."

2. Applied Recommendations

While this study focuses on Hakka walled villages, future applications

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could extend to other ethnic architectural forms—such as Dong drum towers or Miao stilted houses—to explore diverse virtual storytelling strategies and enrich the digital representation of Chinese vernacular architecture. Integrating AI, voice recognition, and motion capture technologies could enhance the interactivity and intelligence of virtual painting environments, enabling deeper viewer engagement and responsive feedback within immersive cultural scenes.

The outcomes of virtual painting can be applied in cultural education, museum exhibitions, and online tours, creating participatory and navigable digital spaces that foster public understanding and appreciation of traditional architecture and folk culture.

This study aims to enable people to experience virtual painting's free creation, liberate artistic sensibility, and reconstruct Hakka walled house culture with Chinese freehand landscape painting's brushstrokes—turning the cultural carrier into a lyrical space to convey traditional "artistic conception" and Hakka folk details. Guided by this, the Walled House Museum (themed "Liberating Artistic Sensibility, Experiencing the Spirit of Painting") designed lightweight experiences to reduce cognitive pressure.

The core "Art Brushstroke Wanderer" experience: Visitors wear simple VR headsets to immerse in a freehand walled house scene. Touching rammed earth walls triggers ripples and the courtyard's "Four Waters Converging into the Hall" effect; minimal annotations let them focus on "moving to feel the artistic conception." A "Realistic-Freehand Comparison Screen" shows real and virtual images—visitors select brushes, tap real details to turn into strokes, and create with brush sounds. Post-creation, they compare works with the artist's, focusing on brushstrokes not quality. The "Artistic Concept Trigger Wall" lets visitors tap scrolls to activate folk scenes (e.g., ancestral worship, fire dragon dance).

These experiences let visitors feel both the walled house architecture and creators' "man-nature symbiosis" conception. This differentiated experience deepens cultural understanding, attracts attention, avoids standardized tourism's overconsumption, and achieves "personalized communication + protective development."

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