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A Study on the Reconstruction of Tourism Scenes by Digital Intelligence Technology from the Perspective of Cultural Ecology: A Case Study of the "Chang'an Twelve Hours" Themed Block in Xi'an

Yuhan Fang

Xi'an International Studies University, Xi'an, Shaanxi, 710128, China

ABSTRACT

As the experience economy deepens and new-generation information technologies achieve comprehensive penetration, the underlying business logic of the tourism industry is undergoing a fundamental shift from being "resource-oriented" to "scene-oriented." Constrained by physical space boundaries and homogeneous competition, the customer acquisition effectiveness of traditional cultural tourism projects has peaked, inevitably pushing the entire industry into a phase of stock-based competition. Against this macro-background, digital intelligence technologies (e.g., mobile internet, smart lighting and visual effects, big data) have broken the rigid constraints of physical space, leaping from auxiliary tools to the core driving force for revitalizing existing physical assets and unlocking commercial value.This study introduces the theory of cultural ecology and constructs a digital-intelligent interactive system of "environment-culture-behavior." Taking the "Chang'an Twelve Hours" themed block in Xi'an as a typical case, it analyzes the reconstruction logic of tourism scenes through digital intelligence technology. The essence of scene reconstruction lies in the deep reorganization of cultural tourism production factors by digital intelligence technology, aiming to achieve a leapfrog improvement in spatial efficiency (revenue per unit area) and commercial premium. Ultimately, this study yields efficiency-oriented operational strategies, providing a standardized reference framework for the digital-intelligent transformation of existing cultural tourism assets.

KEYWORDS

Cultural Ecology; Digital Intelligence Technology; Tourism Scene Reconstruction; Spatial Efficiency.

1. INTRODUCTION

The global cultural tourism industry has entered a period of profound digital-intelligence transformation [1]. The visitor-attraction model of traditional tourist destinations, which relies on singular physical landscapes, has hit a ceiling [2]. As digital intelligence technologies such as mobile digital connectivity, omnipresent intelligent sensing and control, and augmented reality (AR) fully permeate the industry's foundation, the traditional mode of resource allocation has been completely overturned [3-4]. Digital intelligence technology is shedding its role as a mere auxiliary display tool and evolving into the core framework for reshaping tourists' perceptual boundaries and revitalizing existing physical assets. In current industry practice, a large number of digital cultural tourism projects have fallen into the operational dilemma of high investment, low conversion, and rapid decline [5]. The underlying reason is the disconnection between technological application and cultural core, coupled with a lack of systematic theoretical support for scene reconstruction. Mere hardware stacking cannot generate sustained commercial feedback; clarifying how digital intelligence

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technology can be efficiently embedded into cultural tourism scenes to achieve visitor traffic retention and asset monetization is a pressing pain point.

Cultural ecology emphasizes the dynamic balance of "environment-culture-behavior" [6-7]. When introduced into the context of digital-intelligence cultural tourism, the tourism scene is reset from a static sightseeing venue into a precisely operating system: digital infrastructure forms the environmental base, IP content constitutes cultural expression, and tourist interaction is transformed into social behavior. Taking the "Chang'an Twelve Hours" themed block in Xi'an as an example, within its limited indoor commercial volume, it abandoned the stacking of heavy-duty hardware and instead relied on a lightweight digital-intelligence matrix of "mobile mini-programs + site-wide intelligent lighting and projection + digital performances" to achieve a complete reconstruction from an inefficient shopping mall into a high-premium immersive cultural tourism space. This project possesses high value as a sample for analysis. Using it as a vehicle, this paper analyzes the mechanisms of spatial remolding, behavioral intervention, and commercial transformation under the intervention of digital intelligence technology, investigates scene operation strategies with high replicability, and provides an efficiency-oriented practical pathway for the digital-intelligence upgrade of cultural tourism assets.

2. LITERATURE REVIEW

2.1. Digital Intelligence Technology and Tourism Scene Reconstruction

The understanding of tourism scenes in academia and industry has undergone a shift from "physical space display" to "virtual-real integrated interaction." Early digitalization research primarily remained at the tool level, exploring how electronic guides, online booking, and management systems could enhance the service efficiency of tourism destinations [8]. With the maturation of new-generation information technologies such as artificial intelligence, augmented reality (AR), virtual reality (VR), and big data, the research focus has shifted to the deep intervention and reconstruction of the underlying tourism scene by digital intelligence technology [9-10]. Digital intelligence technology is gradually becoming an effective means of breaking the physical boundaries of traditional physical spaces. Some scholars have pointed out that through high-precision holographic lighting and immersive projection, limited indoor physical spaces can be extended into multi-dimensional virtual time-spaces [11]. This reconstruction not only alters the aesthetic presentation of the space, but its more core commercial value lies in exponentially increasing the spatial usage efficiency (i.e., spatial efficiency/revenue per unit area) of cultural tourism projects [12-13]. At the same time, intelligent sensing devices and multi-channel data collection have transformed the traditional one-way sightseeing model, enabling tourists to participate as nodes in the scene's narrative [14].

Current empirical research on cultural tourism projects has also exposed a significant pain point: most studies confine their perspective to the effects of hardware stacking or a single technology acceptance model, lacking guidance from systematic operational logic. The application of technology often becomes disconnected from the cultural core, causing projects to fall into the predicament of "high investment, low conversion, and rapid decline." Clarifying how to shed digital intelligence technology of its mere role as a visual tool and transform it into the core framework for deeply cultivating cultural IP and achieving asset appreciation is the key to resolving the operational bottleneck of existing cultural tourism projects.

2.2. Digital-Intelligent Scene Model from the Perspective of Cultural Ecology

Cultural ecology focuses on the interaction and adaptation mechanisms among various elements within a system. When introduced into the context of digital-intelligence cultural tourism, the fundamental "environment" element is no longer limited to traditional physical buildings or

landscapes, but evolves into an underlying foundation formed by the deep integration of physical space and digital technology[15-16].Within this multi-dimensional, interwoven network, the site-wide intelligent lighting and projection system dynamically regulates the indoor spatio-temporal state (e.g., the changing daylight of the twelve two-hour periods) [17]. This new type of environmental foundation breaks through the sensory boundaries of physical structures, achieves virtual spatial expansion with relatively low computational cost, and provides a flexible carrier for the subsequent display of cultural content and tourist interaction, thereby constructing a composite material-digital base that supports the operation of the entire tourism scene.

Supported by this composite environmental foundation, the manifestation forms and dissemination pathways of the "culture" element have also undergone an essential transformation. The profound Tang Dynasty cultural IP is systematically deconstructed: on one hand, it is integrated into live performances through digital stage design and projection technology, achieving high-intensity visual dimensionality reduction; on the other hand, it is transformed into an identity-based task system on mobile mini-programs via back-end algorithms. Historical symbols are thus reorganized into digital modules that are easy for tourists to execute and perceptually experience [18]. This digitalized cultural expression effectively lowers the cognitive threshold for tourists, enabling cultural content to be integrated into the tour process in a more intuitive manner, thereby achieving high-density cultural output and an immersive experience within a limited physical space.

As the key to the model's dynamic cycle, the "behavior" element is directly manifested in tourists' touring trajectories and interactive feedback within the scene. The intervention of digital intelligence technology has altered the one-way sightseeing model. With the mobile mini-program acting as the hub, the system directly intervenes in tourists' touring routes and commercial decisions by dispatching real-world puzzle-solving tasks and identity verification [19]. Meanwhile, every interaction tourists have within the scene is converted into actual data accumulation, which flows back to the management backend in real time, inversely guiding the resource allocation of the environmental foundation and the updating and iteration of cultural content. At this point, "environment-culture-behavior" forms a self-perfecting closed-loop system within the digital-intelligence context. Through the continuous flow of data and the synergistic interaction of elements, it ultimately drives an overall enhancement of the commercial operational efficiency and asset value of the cultural tourism space.

3. RESEARCH METHODS

3.1. Selection of the Research Object

This study sets the "Chang'an Twelve Hours" themed block in Xi'an as the core analytical vehicle [20-21]. Within a limited and enclosed indoor environment, this project has achieved a complete overhaul of its business model entirely through high-density technological means, thereby intuitively reflecting the actual efficacy of technological intervention on space. In the specific empirical phase, the observation target is precisely segmented into three independent yet interwoven dimensions. On the scene supply side, the focus is anchored on the technology contractor and internal executives who led the block's transformation, aiming to penetrate the surface and reconstruct the original strategies for equipment layout and back-end computing power scheduling. On the behavioral feedback side, the spotlight is directed squarely at the paying consumers. To accurately measure the pull of technology on touring decisions, this paper conducts on-site sampling during peak visitor flow periods such as weekends, selecting 350 tourists who have completed an in-depth experience as samples for behavioral tracking and questionnaire surveys. On the physical monitoring side, attention is zeroed in on the block's benchmark interactive installations, such as holographic performance areas and virtual reality check-in spots, to objectively examine the interaction state between machines and tourists under real operating conditions.

3.2. Data Acquisition and Analysis

To support the subsequent model deduction and conclusion output, the data collection phase spanned both online and offline dimensions, ensuring the diversity of materials and the rigor of cross-validation. During the offline field research phase, the team employed on-site tracking during peak visitor flow periods to conduct covert observation of the 350 target tourist samples previously screened. The core of data capture focused on the average dwell time of tourists in front of key digital-intelligence nodes such as holographic performance areas and AR puzzle check-in spots, the frequency of actively triggering sensing devices, and the immediate consumption conversion rate of making purchases at cultural creative food and beverage outlets directly after completing interactions. These real trajectories in physical space directly constituted the objective parameters for evaluating spatial usage efficiency. On the online dimension, web crawler tools were used to directionally capture 8,523 valid user reviews about the block from mainstream social and travel review platforms over the past six months. Relying on natural language processing (NLP) technology to clean the unstructured text, high-frequency keywords such as "immersion," "interaction," and "holography" were extracted and transformed into quantitative sentiment polarity indicators [22-23]. The two streams of data were ultimately compared and fused in the background, with physical behavior parameters and virtual word-of-mouth indicators interlocking with each other, directly providing a quantitative foundation for analyzing the logic of how digital intelligence technology boosts spatial efficiency (revenue per unit area).

4. RESEARCH ANALYSIS AND RESULTS

4.1. Analysis of the Intervention of Intelligent Interaction on On-Site Behavior and Comme rcial Conversion

In a fully enclosed indoor commercial space, devoid of the support of grand natural landscapes, the operation of the block is highly dependent on the pulling and retention of visitor flow by digital intelligence technology nodes. Tracking data from 350 offline samples show that the interactive network constructed based on digital lighting and mobile terminal devices exerts a remarkably significant intervention effect on tourists' touring routes and consumption decisions. Tourists' average dwell time at core interactive nodes reached 12.5 minutes, and the average frequency of actively triggering online or offline devices per person was 4.2 times. Such high-frequency staying and interaction have thoroughly dismantled the inefficient "corridor effect" typical of traditional commercial blocks. To explore the specific driving mechanism of different technological media on spatial efficiency (revenue per unit area), this study cross-disaggregates the above behavioral averages according to the types of underlying hardware and software.

The above parameters intuitively reveal the division of labor among different digital intelligence forms in "retaining visitor flow" and "facilitating transactions." The comprehensive instant commercial conversion rate as high as 28.6% fully confirms the strong intervention of the digital-intelligence closed loop on the consumption chain. Its underlying operational mechanism can be summarized into the following three aspects:

First, the "visual anchoring" and immersive monetization of the digital light-and-shadow live performance area. In this area (such as the main stage and its surroundings), although the frequency of active user operations per visitor is extremely low (0.8 times), it relies on the seamless integration of high-lumen digital projection and physical stage design to deeply shield tourists' perception of reality. This digitally-assisted visual expressiveness creates extremely strong spatial stickiness, pushing the mandatory visitor retention time to a peak of 16.5 minutes [24-25]. During this prolonged static immersion, tourists are enveloped in high-density cultural emotions, and the surrounding Tang-style catering and cultural creative retail gain abundant opportunities for psychological suggestion, thereby achieving an absolute monetization conversion rate of 34.2%.

Second, the "task-driven" logic and touring route reconfiguration of the mobile mini-program. In contrast to the passive reception in the performance area, the "identity-based task acceptance and real-world puzzle-solving" system deployed on smartphone terminals constitutes the most active interactive hub within the block, boasting an extremely high triggering frequency of 3.5 times per person. By introducing gamified clearance logic, the backend algorithm forcibly transforms originally aimless wandering visitors into "executors" with clear physical displacement goals [26]. The 12.8 minutes of dwell time is largely consumed by online clue comparison, offline scene scanning, and identity verification. The commercial intent of the system lies in the algorithm's precise embedding of check-in points near cold-zone shops or high-margin business formats; the 30.5% conversion rate is essentially a "task-driven associated purchase" induced by data distribution.

Third, the "spatio-temporal folding" and atmospheric underpinning of the site-wide intelligent lighting system. The intelligent lighting and sundial projection network covering the entire block exhibits the lowest direct interaction frequency per visitor (0.2 times) and a relatively bottomed-out conversion rate (21.1%). However, within the entire ecological model, it assumes the foundational infrastructure role of virtual spatial expansion of physical space. By precisely simulating the light and shadow transitions of the "Twelve Hours," it absorbs the overflow crowd from the main thoroughfares at extremely low overt computational cost, bridges the scene gaps between different high-intensity interactive zones, and ensures that tourists' immersive experience does not rupture during movement.

These three types of nodes interweave into a dense data scheduling network within the spatial structure. The interactive triggering of online terminals and the visual interception of offline light and shadow work in synergy; in essence, it is the backend system's control over tourists' physical displacement and the capture of their consumption attention, vividly illustrating how digital intelligence technology, starting from the micro-behavioral level, reconstructs macro-level spatial efficiency and asset monetization efficiency.

4.2. Analysis of Digital Cultural Asset Output Effectiveness and Online Word-of-Mouth Feedback

High-frequency interaction in the physical space resolves the problem of immediate monetization of visitor flow, while the precise output and emotional encapsulation of digital cultural assets serve as the core engine driving the project's subsequent traffic multiplication and brand premium. Mere hardware equipment, lacking the support of a cultural core, is highly susceptible to rapid decline after a brief novelty-seeking phase. Through in-depth mining of 8,523 valid online review texts, this section cross-validates the actual market penetration of the "lightweight digital-intelligence matrix" in transmitting the Tang Dynasty cultural IP.

Through natural language processing (NLP) cleaning and word frequency statistics on unstructured comments, it was found that among all valid texts mentioning the block experience, those covering high-frequency words associated with digital-intelligence perception—such as "light and shadow atmosphere," "mini-program puzzle solving," "immersive interaction," and "identity embodiment"—accounted for as much as 67.4%. This overwhelmingly dominant data proportion powerfully substantiates a commercial fact: the virtual interactive network constructed by site-wide intelligent lighting and mobile terminal devices has successfully surpassed the costly traditional physical antique-style landscaping, becoming the core memory anchor through which audiences recognize this cultural tourism asset. The content spontaneously shared by tourists on social platforms is no longer static architectural photographs, but dynamic light-and-shadow transformations and personal clearance experiences. Behind this qualitative shift in communication lies the digital-intelligence system's successful capture of audience attention.

In terms of sentiment polarity determination, the system extracted core interactive experience vocabulary and assigned corresponding computational weights, ultimately calculating the project's comprehensive sentiment score as 4.62 out of 5 points. The high-score sentiment parameters were

concentrated in the system's "task feedback mechanism" and "visual presentation layer." This result directly verifies, at the data level, the deduced conclusion from the earlier "Digital-Intelligent Scene Interaction Model from the Perspective of Cultural Ecology": the profound traditional Tang Dynasty cultural IP, inherently possessing extremely high cognitive thresholds, has achieved efficient "visual dimensionality reduction" and "interactive dimensionality reduction" after being reorganized by the digital-intelligence system. Historical contexts are no longer presented through dull display boards, but are deconstructed into detective clues on mini-programs and lighting and special effects in the performance area. This modular cultural output strategy greatly caters to the consumption characteristics of modern customer groups who pursue instant sensory stimulation and fast-food-style emotional experiences, effectively reducing tourists' cultural comprehension costs while building a solid word-of-mouth moat for this existing commercial space [27].

4.3. Comprehensive Assessment of Scene Synergy Efficacy and Spatial Efficiency Leap

Isolated single-dimensional parameters are insufficient to reveal the full picture of the underlying commercial operation of a cultural tourism space. By integrating the physical trajectory indicators and virtual sentiment data extracted earlier into the "environment-culture-behavior" closed-loop model for systematic fitting, it is possible to precisely define the substantive driving effect of digital intelligence technology on macro-level spatial efficiency (revenue per unit area) when reorganizing production factors. This paper extracts the "frequency of active interaction per visitor" (independent variable) and the "actual associated commercial conversion rate" (dependent variable) from the 350 offline samples to conduct a Pearson correlation analysis. The data fitting results show that the two exhibit a highly significant positive correlation ($r=0.84$). When tourists' effective interactions within the venue exceed the specific threshold of three times per person, the commercial conversion rate curve climbs steeply, directly breaking through the mean line of 28.6% and approaching the high level of 40%. This data model fundamentally demonstrates that each triggering of light and shadow by the system or each verification of an online task is, in essence, a forceful interception of the physical touring route. The depth of human-computer interaction and the probability of asset monetization form an inseparable and strongly bound relationship here.

Driven by the aforementioned high-frequency interaction mechanisms, the project has achieved a leapfrog growth in spatial efficiency (revenue per unit area) within a fixed and enclosed indoor volume, with its core technological logic lying in "folding space through time." In traditional commercial understanding, spatial efficiency is inherently constrained by the size of physical boundaries. However, site-wide intelligent lighting and mobile mini-program puzzle-solving tasks have artificially and forcibly extended tourists' dwell time in specific areas. Through digital-intelligence means, inefficient corridors and physical dead corners originally used for rapid passage have been precisely segmented by system algorithms into multiple high-immersion and high-frequency transaction nodes. Within an extremely limited number of physical steps, tourists passively expend multiples of dwell time and consumption attention. To further examine this reconstruction process of spatial utilization efficiency, this study conducted slice analysis and simulation deduction on the efficiency transformation of different typical physical nodes within the block (as shown in Table 3).

From the professional perspective of commercial space operation and visitor flow efficiency evaluation, offline physical space can be divided into three typical types of nodes according to their functional attributes, each corresponding to differentiated digital intervention strategies and dwell time performance.

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time performance. Specifically, public corridors and circulation hubs mainly adopt site-wide intelligent lighting and spatiotemporal transition technology, aiming to intervene in natural passage trajectories through dynamic visual content; high spatial efficiency physical stores and their surroundings are equipped with live stage performance design and interactive narrative embedding, utilizing narrative scenes to enhance the sense of presence; peripheral cold zones and physical dead corners are deployed with mobile mini-program clue check-in and verification mechanisms, guiding visitor flow to actively permeate in a task-driven manner.

In the actual measurement of dwell time per visitor, each space exhibits significant differences between the baseline state of purely functional passage or random wandering and the prolonged dwell state after immersive content is triggered: public corridors jump from an average of 1–2 minutes of pure passage to 8.2 minutes of immersive viewing, an increase of 4 to 8 times; physical stores extend from 5–8 minutes of random browsing to 16.5 minutes of in-depth spectating, with the largest absolute increment, reflecting extremely strong user stickiness; while peripheral cold zones further increase from near-zero minimal visits (0–1 minutes) to 12.8 minutes of task exploration, nearly leaping from zero dwell time to medium-to-long dwell time, with particularly prominent activation effects.

Based on the above dwell time data, the efficiency evaluation and commercial conversion rating of each space also present obvious gradients: public corridors are positioned as basic traffic attraction and emotional groundwork, with moderate conversion efficiency—though able to enhance the overall atmosphere, their contribution to direct consumption is limited, focusing more on circulation preheating; physical stores are confirmed as the core areas directly driving surrounding high-margin food & beverage and retail, with extremely high conversion efficiency, where the prolonged stay brought by in-depth spectating is effectively converted into immediate consumption, serving as the main force of overall value output; although the conversion rate in peripheral cold zones is slightly inferior to core areas, their efficiency rating is relatively high due to the function of forcibly activating commercial touchpoints in cold zones, able to effectively revitalize inefficient areas and enhance the overall balance of spatial efficiency.

From this, strategic implications can be drawn: different spaces need to match differentiated digital content intensity and interaction depth. Circulation areas should adopt lightweight, frequently refreshed content; store areas should emphasize heavy narrative and strong social attributes; cold zones are suitable for gamified design and reward closed-loop mechanisms. Although dwell time and conversion efficiency are generally positively correlated, in actual operation, it is still necessary to balance content input costs and output per unit area to avoid diminishing marginal returns caused by over-design, thereby achieving optimal allocation of spatial resources and maximizing the release of commercial value.

Combined with the above data details and correlation analysis, it can be clearly seen that under such extreme resource scheduling, the underlying commercial model of the block has undergone a complete recombination of factors. The foundational environmental base (time-synchronized lighting and projection network) bears the computational load and forcibly retains the physical presence of visitor flow; digital cultural assets (IP storyline and live performances) encapsulate consumption motives and dismantle tourists' psychological defenses against purchasing; terminal interaction actions (online task acceptance and offline purchases) continuously generate structured data, which is fed back into the backend for secondary optimization of commercial circulation routes. These three core elements interlock tightly, shattering the traditional ceiling of growth that existing commercial properties relied solely on physical expansion to drive, with extremely high system operational efficiency, and perfectly delivering the maximization of spatial efficiency and commercial premium of cultural tourism assets at the quantitative level.

5. CONCLUSION AND SUGGESTIONS

5.1. Research Conclusion

Based on the empirical deduction of the "Chang'an Twelve Hours" themed block and the data fitting conducted earlier, this study finds that under the theoretical framework of cultural ecology, the reconstruction of existing cultural tourism scenes by digital intelligence technology is, in essence, a profound reorganization of cultural tourism production factors and a takeover by computational power. This reconstruction process is not a mere stacking of technological hardware, but rather, following the ecological chain of "environment-culture-behavior," it reveals a rigorous and progressively advancing logic of commercial monetization.

Perception technologies integrating the virtual and the real have thoroughly broken the physical space constraints of indoor commercial spaces. Traditional cultural tourism projects are constrained by floor area, facing insurmountable ceilings in visitor carrying capacity and space utilization rates. However, through the intervention of a lightweight digital-intelligence infrastructure consisting of site-wide intelligent lighting systems and spatiotemporal transition, the block successfully reshaped its environmental foundation with the strategy of "folding space through time." This non-destructive digital transformation has broken through the physical boundaries of solid space, not only stitching up commercial dead corners and passage blind spots, but also fissioning originally singular transit spaces into multi-dimensional immersive experience fields. Under the premise of unchanged absolute physical volume, by forcibly prolonging the per-visitor dwell time on site, the system has multiplied the commercial carrying capacity of the scene, constructing a composite material-digital foundation that supports the operation of the entire tourism scene.

The "dual dimensionality reduction" of visual and interactive elements has successfully activated historical cultural IP, achieving efficient and precise output of cultural assets. If presented through traditional static exhibitions, the grand Tang Dynasty culture often fails to stimulate spontaneous consumption among the general public due to high cognitive thresholds. In this scene reconstruction, digital intelligence technology acts as an efficient "cultural translator." The profound cultural IP is systematically transformed into digital visual assets and interactive content: on the one hand, through digital stage design and light-and-shadow special effects in live performances, it forms a strong sensory envelopment; on the other hand, it is deconstructed and reconstructed by backend algorithms into detective clues and experience modules within mobile mini-programs that are easily perceivable and acceptable. This high-frequency, modular output mechanism effectively lowers tourists' cognitive thresholds, reducing abstract and weighty historical symbols into emotional consumer goods that are instantly visible and immediately playable, thereby building a solid foundation for viral word-of-mouth and a brand premium moat for the project.

Algorithm-based micro-behavioral intervention has achieved a leapfrog growth in spatial efficiency (revenue per unit area). The quantitative fitting data in Chapter 4 clearly reveals an extremely strong correlation ($r=0.84$) between the depth of human-computer interaction and asset monetization efficiency. Relying on the synergy of online task verification and offline light-and-shadow interception, the system has thoroughly altered the model of tourists' one-way sightseeing, effectively intervening in their touring routes and consumption decisions. When a visitor's active interactions exceed the critical threshold of three times, their physical touring route is essentially fully taken over by the system. Intelligent terminals and light-and-shadow nodes are no longer mere recreational facilities, but covert "consumption flow restrictors," precisely anchoring visitor flow forcibly within the radiation range of specific high-margin goods. Meanwhile, every interaction of tourists within the scene is transformed into real data accumulation, which flows back to the management backend in real time, inversely guiding the resource allocation of the environmental foundation and the updating and iteration of cultural content.

5.2. Efficiency-Oriented Operational Optimization Suggestions

Based on the foregoing analysis, and addressing the core pain points currently prevalent in the cultural tourism industry—such as peaking customer acquisition effectiveness, high equipment depreciation rates, and sluggish repeat visitation—this study abandons the traditional mindset of "mere hardware stacking" and outputs a comprehensive operational strategy oriented toward commercial efficiency for the digital-intelligent transformation of existing cultural tourism spaces. The core of this strategy lies in breaking free from the constraints of physical boundaries through the meticulous circulation of production factors, thereby achieving the maximization of asset monetization efficiency.

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The primary breakthrough lies in fundamentally transforming the mindset regarding equipment management, preventing projects from falling into the fixed-asset investment trap of being "heavy on hardware, light on operations." Cultural tourism spaces should establish a dynamic resource allocation mechanism based on visitor flow heatmaps and real-time data fed back by sensors. Specifically, during peak visitor flow periods such as weekends or national public holidays, the backend system should automatically increase the frequency of site-wide light-and-shadow changes in public corridors and non-core interactive zones, actively accelerating the movement of peripheral crowds through visual guidance, thereby effectively alleviating congestion pressure on main thoroughfares. Conversely, during off-peak periods like weekdays, the system should precisely channel idle computational power toward deep experience areas (such as core check-in points for real-world puzzle solving or the main venue of holographic performances), deliberately prolonging the dwell time of retained tourists at specific spots. This elastic scheduling not only extends the physical lifespan of core equipment but also achieves an optimal match between hardware energy consumption costs and commercial output in a dynamic game.

After resolving the underlying allocation of computational power, it is imperative to confront the inherent product lifecycle deficiencies of heavily immersive projects. Digital-intelligence initiatives that rely heavily on novelty and visual impact are highly susceptible to the repeat visitation crisis of being "stunning at first sight, yet fatiguing upon return." Therefore, operators must abandon the traditional scenic spot mindset of "one set of scenery lasting five years" and instead treat digital cultural content as internet software products subject to agile development and continuous iteration. Leveraging cutting-edge, low-cost content generation tools such as AIGC (AI-Generated Content), the project can easily establish a regular update mechanism—for instance, by implementing monthly fine-tuning of mission clues on the mobile mini-program and quarterly refreshes of the light-and-shadow performance script. By continuously recombining and piecing together the peripheral fragments of the Tang Dynasty cultural IP, the system can sustain the mystique and freshness of virtual assets at an extremely low marginal cost, thereby ensuring that the digital-intelligence scene generates sustained attraction for local and nearby core customer segments to visit a second or even multiple times, thoroughly shattering the curse of one-time check-in consumption.

To convert the high-frequency interactions within the venue into long-term commercial value, it is essential to change the current crude utilization of data prevalent in most cultural tourism projects. Currently, the industry generally applies data only at the levels of basic "visitor flow counting" and "ticket verification," which is undoubtedly an enormous waste of assets. An ideal digital-intelligence space should fully connect the underlying data links from interactive mobile mini-programs to offline point-of-sale terminals across various business formats. Every subtle action of tourists within the

venue—including plot preferences during puzzle-solving, blind spots where they linger for extended periods, and the final payment details for food, beverage, and cultural creative purchases—must be silently accumulated by the system and profiled into high-precision structured user portraits. These valuable data can be used on-site to optimize physical circulation routes and store traffic diversion strategies in real time; more critically, after tourists leave, these digital profiles will be seamlessly transformed into algorithmic bases for precision marketing in online cultural creative e-commerce and targeted community pushes. This full-cycle data feedback mechanism successfully extends the single, physically constrained on-site consumption infinitely into a full-cycle brand monetization unrestricted by time and space, truly completing the ultimate advancement from "scene operation" to "user asset operation."

6. CONCLUSION

The physical area of cultural tourism spaces is finite, but the commercial imagination brought by digital intelligence technology is boundless. Through the operational realities of "Chang'an Twelve Hours," this study reveals a simple commercial truth: successful scene reconstruction does not lie in blindly piling up expensive technological hardware, but in how to use the most lightweight technology to retain "people." When the dynamic light and shadow atmosphere and convenient mobile phone interactions are truly integrated into the rhythm of the visit, the cursory "one-time consumption" typical of traditional scenic spots is naturally transformed into a deeply immersive "high-frequency experience." This not only deftly resolves the inherent shortcoming of limited floor area in indoor commercial properties, but also points a pragmatic, low-cost, high-return transformation path for the large number of traditional cultural tourism projects in China currently facing customer acquisition dilemmas.

Looking to the future, competition in the cultural tourism industry will eventually move beyond a mere contest of "landscape creation." In this digital wave, whoever can transform short-lived offline physical visits into long-lasting online user connections will stand out in the second half of the experience economy. And digital intelligence technology is precisely the best cornerstone for building this bridge.

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