

Leveraging Digital Technology for Tourism Enhancement in the Yuejiang Tower Historic District of Zhaoqing City

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Abstract: This study focuses on the Yuejiang tower Historic District in Zhaoqing City, Guangdong Province. By tracing its developmental track and analyzing the current state of regional planning, the research explores the district's historical, cultural, artistic, and tourism values from the perspective of digital tourism development. Building on this foundation, the study delves into the construction of cultural spaces within historic district in the context of digital urban development. Through a systematic investigation of the current tourism development in the Yuejiang tower district, the research identifies and examines key issues from multiple perspectives. The study explores the application of cultural space concepts in historic district and proposes a sustainable development-oriented approach to create an environment aligned with the "Host-guest sharing" principle. This approach aims to promote the coordinated development of tourism economies and cultural heritage preservation. Additionally, the research presents specific strategies for constructing tourism spaces to facilitate the rational layout and functional integration of the Yuejiang tower historic district within a digital urban framework. The findings of this study are expected to provide practical recommendations for the tourism development of historic district in Zhaoqing City. Moreover, they offer new perspectives for the development of other historic districts within the Pearl River Delta (PRD) Area, contributing practical insights to the advancement of local tourism economies.

Keywords: Digital Technology; Yuejiang Tower; Historic District; Smart Tourism

1. Introduction

Under the influence of globalization and

urbanization, historic districts, as an essential component of urban cultural heritage, showcase their unique historical features and rich cultural connotations. However, with the continuous advancement of urbanization, these districts face the dual challenges of preservation and development. Traditional models of preservation and operation, primarily driven by government-led planning and implementation, have gradually revealed issues such as insufficient cultural heritage transmission and weak protection of architectural styles and living environments [1]. These models are increasingly unable to effectively respond to the pressures brought about by urban construction transformation and upgrading. This contradiction has led many historically significant and culturally valuable districts, during the process of development and preservation, to often transform into models of excessive commercialization and gentrification, thereby losing their original cultural appeal and historical value [2].

To address this challenge and enhance the scientific and systematic nature of the renovation and construction of historic districts, scholars have recently explored the integration of modern technological approaches, such as information technology and intelligent methods, to promote the smart renewal of these areas. With the continuous development of digital, informational, and intelligent technologies, smart cities and smart tourism have gradually become hot topics. Particularly in the context of the preservation and utilization of historic cultural districts, the introduction of the smart city concept offers new perspectives and methodologies for addressing these issues. The core objective of smart cities is to enhance urban management efficiency through the application of digital technologies, improve residents' quality of life, and promote the sustainable development of

urban culture and tourism [3]. In the case of historic cultural districts, the integration of smart city principles can play a crucial role in improving public services, optimizing consumer experiences, strengthening the protection of historical and cultural heritage, and facilitating the dissemination of local culture, thus serving as a key factor in driving the sustainable development of these areas.

In recent years, the construction of smart cities has achieved significant results across various sectors, particularly in public services and urban management. The development of smart cities enables the efficient sharing and management of urban information. Moreover, technologies such as big data, cloud computing, and the Internet of Things (IoT) can be harnessed to enhance the development strategies and management models of historic districts, especially in heritage preservation and tourism development [4]. Digital technologies offer enhanced capabilities for analyzing and forecasting tourism demand, while also improving the interactive experiences of visitors [5]. These advancements allow tourists to more deeply engage with and appreciate the allure of historical and cultural heritage. Moreover, innovative cultural display techniques, such as Virtual Reality (VR) and Augmented Reality

(AR), present novel opportunities for tourism development in historical and cultural districts [6]. By enabling a more vivid and immersive exploration of cultural heritage, these technologies contribute to the preservation and revitalization of cultural values in historically significant areas.

Zhaoqing, a prefecture-level city in Guangdong Province, is a key node in the Pearl River Delta Area. It is an integral part of both the "Guangfo Zhaoqing Economic Circle" and the Pearl River–West River Economic Belt. From 2015 to 2019, Zhaoqing experienced consistent growth in both domestic and international tourism, with annual visitor numbers exceeding 10 million and displaying a steady upward trajectory (Figure 1). However, the onset of the COVID-19 pandemic and other external factors in 2020 led to a dramatic decline, with domestic tourist numbers plummeting to 4.98 million and international visitors falling to just 37,000. By 2023, visitor numbers had partially recovered to 6.912 million, yet remained over 50% below Pre-pandemic levels. These trends underscore the profound challenges facing Zhaoqing's tourism sector in the post-pandemic period and highlight the pressing need for innovative strategies to foster recovery and growth.

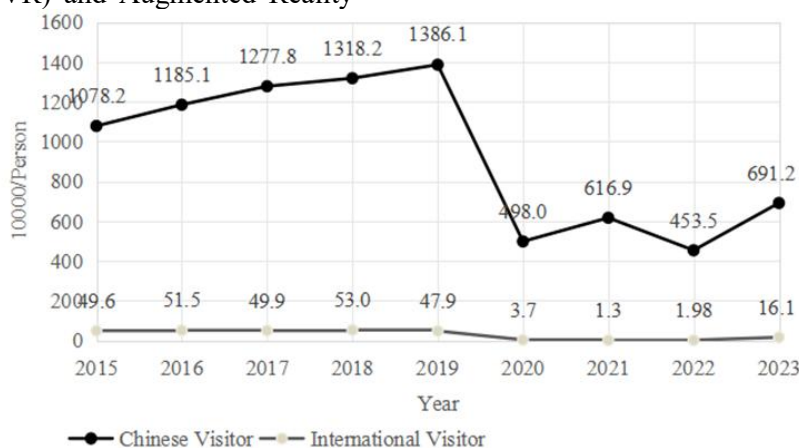


Figure 1. Statistics on Visitor Reception in Zhaoqing City, 2015-2023

Zhaoqing serves as the cradle of Lingnan and Xijiang cultures, with its abundant historical and cultural heritage enriching the city's tourism with a distinctive cultural depth. However, compared to other cities in the Pearl River Delta region, Zhaoqing still faces certain shortcomings in tourism development and innovation. Despite its rich natural landscapes and historical-cultural resources, the city lags behind in the in-depth development of its

historical and cultural assets and in the advancement of digital tourism. For instance, cities like Guangzhou, Shenzhen, and Zhuhai have made significant progress in leveraging digital technologies, building smart tourism platforms, and integrating cultural and tourism industries, which has granted them strong competitive advantages. To enhance its competitiveness within the Greater Bay Area, Zhaoqing should prioritize the digital

transformation of its tourism industry by leveraging big data and artificial intelligence to optimize the visitor experience. Simultaneously, it is essential to innovate and integrate its historical and cultural assets into unique cultural tourism products, creating a distinct and appealing market position.

This study aims to explore the development pathways for smart tourism in the Yuejiang tower historic district of Zhaoqing city within the context of smart cities. It investigates how digital technologies and intelligent systems can be leveraged to promote sustainable tourism development in the area. By analyzing the relationship between smart city construction and the tourism development of historic districts, this research delves into the application of digital technologies in the renewal processes of historic districts. Special focus is placed on technologies for enhancing visitor experiences, optimizing management models, and advancing the preservation and transmission of historical and cultural heritage. This study not only contributes to the theoretical enrichment of applying smart city concepts in the field of cultural heritage conservation but also provides practical insights and references for advancing the smart development of historic districts.

2. Analysis of the Status of Historic District

According to the Zhaoqing Historical and Cultural City Conservation Plan (2021–2035) (Draft) released in October 2023, the protection scope of the Yuejiang Road Historic District is categorized into three levels based

on the historical value and building density: the underground archaeological site protection zone, the core protection area, and the construction control and landscape coordination zone. The planning document also identified a series of cultural heritage resources slated for conservation, including ancient villages, historical urban areas, ancient city walls, and historic districts, among which the Yuejiang tower historic district is prominently included (Figure 2).

The Yuejiang tower historic district is located on the eastern outskirts of Duanzhou District, the central urban area of Zhaoqing City. Centered around the ancient Yuejiang tower, the block gradually took shape over time. It is Unlike structures with the same name in cities such as Nanjing, Zhaoqing's Yuejiang tower, also known as Songtai academy, was originally built in the 14th year of the Chongzhen reign during the Ming Dynasty (1641) and was named Yuejiang tower. Historically, the tower served not only as an academy and a gathering place for scholars and literary figures but also played a significant role in military defense. The block encapsulates Zhaoqing's integration and adoption of Central Plains culture, its emphasis on education and Confucian values, and its subsequent promotion of cultural prosperity. This trajectory underscores its prominent role as the cultural hub of the Xijiang River region, demonstrating exceptional cultural and social significance and establishing it as a key origin of Cantonese culture.



Figure 2. Schematic Diagram of the Historical District of Yuejiang Tower in Zhaoqing City

The Yuejiang tower Historic district features a diverse range of architectural styles, most of which reflect the distinctive building culture of the Lingnan region. The block preserves many public buildings and residences with traditional Lingnan characteristics, including unique historical and cultural structures such as row houses with arcade-style façades blending Chinese and Western architectural elements. These buildings exhibit high historical, technical, and artistic value. Additionally, the block is a repository of rich religious culture and, as a significant birthplace of modern revolutionary movements, holds considerable historical and cultural importance.

2.1 Analysis of Street Spatial Layout

The Yuejiang tower historic district serves as a quintessential example of the integration of Cantonese culture with Western influences, showcasing the area's distinctive historical significance and profound cultural heritage through its street and alley spaces. As a core landscape feature of the district, the arcaded streets represented by Zhengdong road seamlessly blend the Western concept of arcades with the functional practicality of traditional Lingnan architecture. Constructed primarily with brick-and-mortar structures, the arcade buildings retain the defining characteristics of traditional Lingnan streets and alleys. The narrow, winding streets, along with architectural details such as grey tiles, decorative windows, and intricately carved doorways, collectively create an urban district that exudes the unique charm of Lingnan culture while bearing historical traces of East-

West cultural fusion. The layout of the streets and alleys is thoughtfully designed to optimize ventilation, natural lighting, and pedestrian flow, with a typical width of 3 to 4 meters, balancing commercial functionality with everyday convenience. The ground floors of the buildings are often designated as storefronts, forming a distinctive arcade-style commercial cluster that reflects the regional character [7]. The storefronts connect seamlessly with the covered arcade corridors, providing residents and visitors with shaded, rain-protected spaces, thereby embodying the practical wisdom of Lingnan culture in its approach to everyday living.

2.2 Overview of the Spatial Layout

The Yuejiang tower historic district boasts a wealth of historical relics, including three immovable cultural heritage sites. Among them is Yuejiang tower, an architectural masterpiece from the Chongzhen period of the Ming Dynasty. Additionally, the block is home to 26 historic buildings characterized by traditional architectural styles. These heritage assets encompass nationally protected sites, as well as those under municipal and district-level protection, alongside unregistered immovable cultural relics, collectively reflecting a profound historical and cultural legacy (Table 1). For instance, in 1959, Yuejiang tower was repurposed as a memorial museum commemorating the former headquarters of the Ye Ting Independent Regiment, a revolutionary military unit that played a significant role in the nation's struggle for independence and liberation.

Table 1. List of Historical Landscapes in Yuejiang Tower Historic District

Item	Object	Count
Protective Courtyard	Songtai Academy 's former courtyard	1
	Yuejiang tower's courtyard	1
	Ye Ting independence regiment memorial hall courtyard of the former site	1
	Gaoyao Confucian Temple's courtyard	1
Historical Building	Arcade buildings No.127,43,44,46,47 of Zhengdong Road	5
	Arcade building No.161	1
	Lingji Warehouse Former Site	1
	Tongji Warehouse Former Site	1
	Chen family courtyard in Yuejiang road	1
	The Former Site of Yiyan Tower	1
	Mosque located on the west side of Zhaoqing city	1
	Residential Buildings at No. 18, 19, 20, 21, 52, 5, 6, and 7 Xingxiangli Road	6
	Chongzhen Pagoda, Yuejiang tower, Songtai Academy, Gaoyao Confucian Temple	4

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Overall, the Yuejiang tower Historic district boasts a unique combination of natural landscapes, historical architecture, and rich local customs. The district preserves numerous historical buildings from the Ming and Qing dynasties, along with several immovable cultural relics and traditional architectural features from the wartime era. At the same time, it hosts a variety of culturally creative spaces such as bookstores, photography studios, and cafes, exuding a vibrant artistic atmosphere. This seamless integration of tradition and modernity not only continues the city's historical legacy but also infuses it with dynamic contemporary cultural elements. Such a district, embodying both historical significance and modern charm, aligns perfectly with the aspirations of tourists seeking an authentic experience of Lingnan culture, making it exceptionally attractive. The cultural richness and distinctive value embedded in the Yuejiang tower historic district form the core resources for Zhaoqing's tourism branding and represent a unique advantage that cannot be replicated by artificial landscapes. Therefore, it is essential to protect and develop this district effectively, ensuring its cultural value is recognized in the tourism market. This approach can drive the sustainable development of the tourism sector in both the Pearl River Delta region and Zhaoqing, ultimately enhancing the role of tourism in fostering urban economic growth.

3. The Current Situation of Historic District

3.1 The Mediums of Cultural Display Lack Diversity

The essence and significance of culture are best conveyed through specific carriers, and the greater the diversity of these carriers, the more comprehensively and vividly the cultural core of a block area can be communicated. This allows visitors to gain a clearer and deeper appreciation of its cultural value. In the Yuejiang tower historic district, cultural resources are primarily presented through a cohesive system of static, tangible, and complete carriers. These include architectural designs, gardens, statues, sculptures, exhibits, paintings, and decorative artworks, complemented by informational plaques that provide visitors with a basic introduction. While this traditional approach to cultural presentation is a widely adopted method in tourism promotion, it primarily reflects the surface-level aspects of tourism culture. Consequently, it often falls short of meeting visitors' growing demand for a more profound and immersive understanding of the cultural connotations underlying humanistic landscapes.

3.2 Lack of Cultural Elements in Tourist Facilities

Field investigations indicate that the Yuejiang tower historic district suffers from a lack of cohesive integration between its historical and cultural elements and its tourism facilities. Currently, these facilities are designed primarily to meet visitors' basic functional needs, with limited attention to aesthetic value or cultural immersion. For instance, the Ye Ting independent regiment memorial hall, which centers on the culture of the war of resistance, features rest areas furnished with basic stone and wooden benches. Similarly, signposts and trash bins, predominantly constructed from iron, reflect a modern industrial style that is incongruous with the district's historical heritage. The paving design, combining large stone slabs and cobblestones, also fails to capture the unique historical character of the area. Furthermore, the local food offerings and tourism souvenirs lack distinctive cultural attributes, providing visitors with little lasting connection to the region's heritage. High-quality souvenirs, imbued with rich cultural significance, could foster deeper emotional resonance, allowing visitors to recall and appreciate the district's heritage while serving as "mobile business card" to enhance its visibility and appeal [8].

3.3 The Street Spaces Lack Proper Maintenance

The development of commercial public spaces and residential private areas is unbalanced, and synergistic development has yet to be achieved. For example, certain streets and alleys, such as those along Xueqian West Road, remain abandoned and underutilized. Binjiang Third Road, which connects to the modern waterfront area, disrupts the uniformity and coherence of the district's architectural character. Additionally, the district's land use planning, which prioritizes commercial activities, inadequately supports the preservation and transmission of its regional folk culture. For example, cultural activities such as folk performances, anti-war cultural performances, and the Gaoyao Confucian Temple cultural exhibitions are staged as live performances during specific time periods, resulting in the inheritance of these traditions being constrained by technological limitations in methods and modes of dissemination. Furthermore, unauthorized modifications to shopfronts along the commercial street have disrupted the uniformity of the architectural façade. On both sides of Zhengdong Road, the multi-story arcade-style buildings are frequently altered or expanded by residents without authorization, compromising the authenticity of the traditional residential forms in the old town. During peak periods such as holidays, the district experiences high population density, reducing pedestrian comfort. Particularly at street intersections, pedestrian and vehicular flows intersect without effective management, leading to congestion. Lastly, the public service facility system in the old town is inadequate, lacking user-friendly amenities such as rest areas, barrier-free access, signage and wayfinding systems, and self-service facilities. The maintenance and management efficiency of existing facilities is also low.

4. Smart Tourism Path Development Strategy

4.1 Build the Smart Tourism Space

The participation of local residents is key to cultural revitalization, as their unique contributions enhance the appeal of tourism development [9]. Tourism planning should

shift from a “top-down” dominant design approach to a “bottom-up” participatory design approach to inspire residents' enthusiasm. This can be achieved by employing tools such as satisfaction surveys and local cultural documentaries to raise awareness of cultural preservation. Past successful cases demonstrate that revitalizing historical and neighborhood cultures through creative reinterpretation can inject new vitality into districts, creating virtual pre-modern living scenarios that engage tourists in temporal and spatial interactions with the past [10].

Based on this, the Yuejiang tower historic district should position itself with a core focus on integrating historical relics with cultural and creative arts, targeting young tourists with an affinity for nostalgic and sophisticated experiences. Under the existing conservation model, cultural revitalization and enhancement should be advanced across macro, meso, and micro levels, centered on innovative cultural imagery. Efforts should aim to improve visitor experiences and interaction methods, optimize environmental perception, and construct a smart tourism space. Furthermore, the coordinated development of architectural aesthetics and spatial forms is a critical factor for balanced district development [11]. By establishing quantitative standards to collect architectural data—such as location, volume, style, and preservation status—and applying statistical and visual analysis, heat distribution maps can be generated to provide data-driven design references. This approach supports the establishment of a regional renewal feedback mechanism, prevents overdevelopment, and ensures coordinated and sustainable urban renewal.

4.2 Digital Image Regeneration of Historic Districts

According to the Zhaoqing Historic and Cultural City Protection Plan (2021–2035), Zhaoqing City aims to develop six historical and cultural tourism routes within Guangdong Province and three cultural heritage tourism routes connecting the Pearl River Delta region. Within the historic city center, three primary cultural tourism trails are proposed: the Fucheng Historical and Cultural Trail, the Ancient City Flood Defense Trail, and the Sino-Western Cultural Exchange Trail. These trails will revolve around historical resources

such as the Yuejiang tower, the Gaoyao Confucian Temple, and the former headquarters of Ye Ting's Independent Regiment, integrating the scenic West River waterfront to provide a distinctive cultural tourism experience. The plan incorporates holographic projection and virtual reality (VR) technologies to construct immersive cultural and art exhibition spaces, presenting historical scenes and narratives along a timeline to enhance visitor engagement and immersion [12]. This approach aims to facilitate innovative dissemination and sustainable utilization of historical and cultural resources. For instance, in the Yuejiang tower historic district, 3D scanning and digital modeling technologies can be employed to reconstruct the architectural history, complemented by digital mapping to showcase the construction process. Narrative-driven designs could embed key historical events, allowing visitors to experience transitions between different historical scenarios during their tour [13]. These scenarios might include the construction of Yuejiang tower, naval inspections during the anti-Qing resistance, and the establishment of Ye Ting's Independent Regiment. This study proposes a framework that integrates multiple digital technologies to showcase architectural heritage, daily life, and local folk culture. By leveraging these technologies, visitors can "travel" to different historical periods, thereby deepening their understanding of and emotional connection to Zhaoqing's cultural heritage [14].

4.3 Intelligent Neighborhood Services

From the perspective of visitors, a location-based contextual sharing platform is utilized to vividly and realistically present spatial data of the district. This platform provides services such as district scene maps, audio guides, route planning, and facility searches, enabling visitors to gain a comprehensive understanding of the district's layout [15]. By recommending points of interest and optimizing routes, the platform enhances touring efficiency and user experience. Additionally, it leverages real-time crowd monitoring and dynamic analysis technologies to improve visitor flow management, prevent overcrowding, and strengthen safety and emergency response capabilities. Based on an analysis of visitors' place of origin, the platform can also design

targeted commercial or cultural activities to optimize the district's public service capacity and enrich the visitor experience [16]. In terms of supporting facility design, the platform integrates historical architectural styles with thematic elements to optimize shop signage, wayfinding systems, and lighting designs, fostering a unique cultural atmosphere that blends modernity with history. The overall plan aims to achieve intelligent upgrades to district services, enhance visitor satisfaction and operational efficiency, and inject new vitality into the district's development.

4.4 Neighborhood Management Informatization

From a management perspective, the smart district's information management platform, centered on digital infrastructure, establishes an application system, unified data center, integrated dispatch center, and security system. This framework enables comprehensive IoT-based management of public facilities within the district, improving maintenance and operational efficiency while strengthening regulatory oversight [17]. Through the application of digital technology, a platform for the "Yuejiang tower Digital Shared Cultural Space" can be developed, allowing the cultural essence of the district to be presented and disseminated through multiple channels. This initiative aims to transform the Yuejiang tower historic district into a new landmark for tourism in Zhaoqing city. A smart tourism service system, built upon digital technology, further enhances the "Yuejiang tower Smart Tourism" system, providing visitors with a more intuitive, diverse, and user-friendly "digital block" experience. The platform integrates navigation, guided tours, cultural and historical information, surrounding area insights, and shopping assistance. Additionally, advanced technologies such as intelligent robots and VR are incorporated to create immersive experience spaces, enabling the intelligent management and services of district attractions and shops. This approach fosters a deep integration of Zhaoqing's historical culture with modern technology, driving the high-quality development of the smart block.

4.5 Tourism Image Virtualization

In the construction of digital virtual cultural spaces, VR technology should be fully

integrated with tourism services to create immersive virtual tourism experiences of historical sites, museums, and attractions [18]. By leveraging VR devices, citizens can experience the unique charm of the Yuejiang tower historic district without leaving their homes. This approach encompasses not only the district's historical and cultural heritage and architectural scenes but also provides panoramic displays of its dining, hospitality, and other service industries, as well as its surrounding environment, offering comprehensive reference information on food, accommodation, and transportation for visitors. With the application of online 3D visualization technologies, tourists can quickly access detailed information about the district's services, facilitating itinerary planning and accommodation selection [19]. Additionally, a VR-based online exhibition platform can be established to integrate cultural resources within the Yuejiang tower historic district, such as historical sites, museums, traditional residences. This platform could offer features like virtual interaction and VR tours, enabling visitors to explore the district's cultural heritage comprehensively. Through this website, tourists can gain an in-depth understanding of the district's cultural characteristics and enjoy immersive experiences of historical architecture and artifact exhibitions, thereby achieving a dual enhancement in cultural dissemination and tourism experience.

5. Conclusion

This study conducts an in-depth analysis of the spatial layout, historical and cultural resources, and current challenges of the Yuejiang tower historic district in Zhaoqing City. It summarizes the challenges faced in tourism development and proposes smart tourism development strategies based on digital technologies. This integrated digital development approach not only provides a new perspective for the evolution of historic districts but also enhances public awareness and engagement with historical culture. By adopting this method, the Yuejiang tower historic district can be transformed into a new landmark in Zhaoqing city, strengthening its value as a representation of local history and culture while also driving local socio-economic development. The design of this

framework takes into account both the feasibility and practicality of the technologies employed, ensuring the sustainability and effectiveness of historical and cultural preservation efforts. Furthermore, it offers valuable insights and references for future research and applications in similar fields.

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