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STRATEGIES FOR EMPLOYING VIRTUAL REALITY IN PRESERVING THE AESTHETIC EXPERIENCE OF HERITAGE SITES AND THEIR INTERIOR ARCHITECTURE IN THE CITY OF TAIF AND ENHANCING ACCESSIBILITY: A LITERATURE REVIEW

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ABSTRACT

This comprehensive literature review examines strategies for employing Virtual Reality (VR) to preserve the aesthetic experience and enhance public access to the interior architectural heritage of historical buildings, with a specific focus on Taif city in the Kingdom of Saudi Arabia. In the context of global digital preservation trends and Saudi Vision 2030's emphasis on cultural tourism and technological innovation, the study synthesizes contemporary research to address a significant gap in the application of VR to the unique interior architectural heritage landscape of Taif. The review establishes a theoretical framework centered on the multisensory nature of aesthetic experience within heritage interiors, and the core VR concepts of immersion, presence, and interactivity. It subsequently analyzes effective technological pipelines, such as integrated LiDAR and photogrammetry for high-fidelity documentation of interior architectural elements—walls, floors, ceilings, windows, doors, and decorative motifs—and design approaches for multi-sensory, narrative-driven VR environments. The paper identifies the specific aesthetic and accessibility challenges facing Taif's heritage architecture, including the sensitivity of interior architectural elements like the Rowshan (wooden lattice window), risks to intangible heritage linked to interior spaces, and geographic barriers. In response, it proposes a tailored, multi-phase VR strategy framework that spans collaborative digital documentation of heritage interiors, the development of tiered VR/AR experiences, integration with education and sustainable tourism, and mechanisms for ongoing evaluation. A critical analysis addresses concomitant technical, ethical, and user-experience challenges, such as cost, authenticity, community involvement, and inclusive design. The review concludes that VR holds transformative potential for Taif, not as a replacement for physical heritage, but as a vital complementary tool for the conservation of its interior architectural legacy, democratizing access, fostering global engagement, and ensuring the sustainable stewardship of its cultural built heritage for future generations.

KEYWORDS: Virtual Reality (VR), Cultural Heritage Preservation, Interior Architectural Heritage, Aesthetic Experience, Interior Spaces, Digital Access, Taif City, Kingdom of Saudi Arabia

1. INTRODUCTION

Background of the Study

Heritage Preservation in the Digital Age

The preservation of cultural heritage has entered a transformative era, moving beyond physical conservation to embrace digital stewardship. Global challenges, including environmental degradation, unsustainable tourism, and conflict, have accelerated the imperative to create durable, accessible digital records of at-risk sites and artifacts (Paladini *et al.*, 2019; Zhang *et al.*, 2025). This digital shift is not merely about archiving; it is fundamentally about expanding public access, enabling new forms of scholarly research, and fostering a deeper, more democratic connection with our shared past. Visionary projects, such as UNESCO's "Dive into Heritage" platform—launched in 2025 with support from the Kingdom of Saudi Arabia—epitomize this global trend. This initiative uses detailed 3D models, virtual reality (VR), and augmented reality (AR) to bring World Heritage sites to a global audience, demonstrating how digital tools can enhance understanding and appreciation of cultural assets (UNESCO, 2025). Concurrently, nations like Kingdom of Saudi Arabia, guided by its Vision 2030 framework, are strategically positioning themselves as leaders in this field. The nation's goal is to leverage immersive technologies, VR, AR, and the metaverse, to diversify its economy, promote cultural tourism, and showcase its rich history to the world (Alkhaliel, 2022). This confluence of global necessity and national vision creates a critical context for examining specific, localized applications of digital heritage strategies. This confluence of global necessity and national vision creates a critical context for examining specific, localized applications of digital heritage strategies, particularly for safeguarding the interior architectural heritage of cities like Taif.

The Aesthetic Dimension of Heritage: Beyond Physical Conservation

Traditional heritage conservation has primarily focused on the material integrity of structures. However, a comprehensive preservation strategy must also safeguard the aesthetic experience of interior spaces—the multisensory, emotional, and cognitive engagement evoked by heritage interiors. This includes the play of light and shadow on intricate interior architectural details, the acoustic properties of a room, the tactile quality of wall finishes and flooring materials, and the embodied feeling of moving through a historical interior environment. These intangible qualities are central to a site's cultural meaning and visitor impact but are often the most

vulnerable to loss through deterioration, inappropriate restoration, or sheer physical distance (Zhang *et al.*, 2023). Digital technologies offer unprecedented tools to capture, analyze, and re-present these interior aesthetic dimensions. High-resolution 3D scanning can record surface texture at a sub-millimeter level, preserving the craftsmanship of a stone carving. Photogrammetry can capture the precise color and luminosity of a mural under specific lighting conditions. When integrated into VR environments, these datasets allow for the reconstruction of not just the geometry of a space but its entire interior ambiance, enabling remote users to have a qualitatively rich, immersive experience that approaches the aesthetic encounter of an in-person visit (Sun *et al.*, 2024; Zhou & Li, 2024). This capability shifts the paradigm from preservation-as-documentation to preservation-as-experiential-access.

Virtual Reality as a Tool for Cultural Heritage Engagement

Virtual Reality has evolved from a novel visualization tool into a sophisticated medium for cultural heritage engagement, capable of facilitating deep immersion and interactive learning. VR applications in this domain can be broadly categorized into several key functions, as identified in recent bibliometric analyses: 3D reconstruction, virtual museums, tourism, education, and the preservation of intangible heritage (Zhong *et al.*, 2021; Zhang *et al.*, 2025). The technology enables two primary modes of engagement: virtual reconstruction, which allows users to explore sites as they appeared in different historical periods or as they exist in a meticulously documented present; and virtual restoration, which can visually repair damage or simulate the original appearance of degraded elements for study and appreciation (Pietroni & Ferdani, 2021). A significant advantage of VR is its capacity to democratize access. It removes geographical, physical, and socioeconomic barriers, allowing individuals worldwide, including those unable to travel, to visit remote or sensitive heritage locations (Selmanović *et al.*, 2020). Furthermore, by incorporating narrative elements, gamification, and interactive storytelling, VR transforms passive observation into an active, engaging educational journey, making complex historical and cultural contexts more accessible and memorable, particularly for younger audiences (Champion & Foka, 2020; Rani *et al.*, 2023).

Rationale of the Study: The Interior Architectural Heritage of Taif City

Taif City in the Kingdom of Saudi Arabia presents a compelling and urgent case study for the application of VR in interior heritage preservation.

The city possesses a rich and layered architectural legacy, from historic Ottoman-era structures like Al-Kaaki Palace to distinctive vernacular buildings featuring iconic interior elements such as the Rowshan (projected wooden window) and ornate courtyard layouts (Al-Zahrani, 2018; Alhuseini et al., 2023). These interior spaces are not merely functional enclosures but embody the cultural identity, climatic intelligence, and social rituals of the Hijaz region. However, this heritage faces significant threats from rapid urban development, environmental factors, and the delicate balance between preservation and contemporary use (Al-Baqmi, 2021; Waheeb et al., 2023).

Despite the Kingdom's Vision 2030 emphasis on cultural tourism and digital innovation (Alkhaliel, 2022), a significant gap persists in the literature: a focused, systematic review of how VR strategies can be specifically tailored to preserve the unique aesthetic character and spatial experience of Taif's interior architectural heritage while enhancing its accessibility. Existing research has explored Taif's urban fabric (Al-Baqmi, 2021) and user-centered design principles (Alsabban & Alotaibi, 2025), but has not comprehensively addressed the application of immersive technologies to the documentation, sensory preservation, and virtual engagement of its heritage interiors. This review seeks to fill that gap, proposing a tailored framework that situates Taif's interior heritage within both national strategic vision and global digital preservation practices.

Objectives and Scope of the Study

This literature review synthesizes contemporary research on VR strategies for cultural heritage, focusing on their potential to preserve the aesthetic experience of interior architectural spaces and enhance their accessibility. It aims to review technological pipelines for preserving heritage interiors, analyze frameworks for interior aesthetic perception, synthesize applications for access and community engagement, and evaluate implementation opportunities and challenges within Taif city, aligned with the Kingdom of Saudi Arabia's Vision 2030. Guided by literature from approximately 2015 onward, the review is structured around the central research question: What are the most effective digital documentation technologies for capturing the aesthetic and spatial qualities of interior architectural heritage typologies in Taif, such as ornate woodwork, wall paintings, and spatial configurations?

Theoretical Framework

Defining "Aesthetic Experience" in the Context of Heritage Sites

The aesthetic experience of a heritage interior

transcends mere visual appreciation; it is a holistic, multisensory, and cognitive engagement that evokes emotional and reflective responses. Within the framework of environmental aesthetics, this experience involves an interactive relationship between the perceiver and the perceived interior environment, where qualities like spatial form, interior lighting, surface materiality, acoustic properties, and historical narrative coalesce to create meaning (Zhang et al., 2023). In a heritage context, this experience is profoundly linked to notions of authenticity and atmosphere. For example, the intricate geometry and filtered light of a Hijazi Rowshan window illuminating a room or the spatial sequence and material finishes of a Taif courtyard house are not just architectural features but are central to crafting a specific interior aesthetic and cultural ambiance (Abass et al., 2016). Recent scholarship advocates for a "human-centered aesthetic" in digital heritage, arguing that preservation must aim to sustain these experiential qualities of heritage interiors—the sense of awe, historical connection, and cultural understanding—rather than just the physical fabric (Lin et al., 2025; Chen et al., 2025). This reframing is crucial for evaluating VR's success for interior spaces; a virtual model is not merely a replica but should be assessed on its capacity to facilitate a comparably rich and evocative interior aesthetic encounter.

Conceptualizing Virtual Reality: Immersion, Presence, and Interactivity

The efficacy of VR as a medium for heritage engagement is underpinned by three interrelated core concepts: immersion, presence, and interactivity. Immersion is an objective description of the system's technical capabilities, the extent to which a VR system presents a vivid, contiguous, and multimodal environment that blocks out stimuli from the physical world (Cecotti, 2022). High-fidelity graphics, spatial audio, and wide fields of view contribute to a higher degree of immersion. Presence (or "telepresence") is the user's subjective psychological response—the compelling sensation of "being there" within the mediated environment (Zhao, 2021). In heritage applications, a specialized form known as cultural presence is sought, where users feel a meaningful connection to the historical or social context of the virtual place, not just its geometry (Zhao, 2021; Champion & Foka, 2020). This is fostered through narrative cues, contextual sounds, and interactive elements that suggest past human activity. Interactivity is the engine that transforms a passive viewing into an active exploration. It encompasses the user's ability to navigate, manipulate objects, trigger information,

and influence the sequence of events within the virtual environment (Albourae, 2024). The synergy of these three elements, where a technically immersive system (immersion) facilitates a believable sense of place (presence) through user-driven exploration (interactivity), is what defines a compelling and educationally potent VR heritage experience. This framework moves the evaluation of VR beyond graphical realism to assess its success in fostering meaningful engagement and empathetic understanding.

Models of Digital Heritage Preservation and Access

The field has evolved from simple digital archiving to complex models that integrate preservation with active public engagement. A foundational distinction lies between Virtual Reconstruction and Virtual Restoration (Pietroni & Ferdani, 2021). Virtual reconstruction involves creating digital models of sites or artifacts that no longer exist or are inaccessible, based on historical, archaeological, and architectural evidence. Virtual restoration, conversely, involves digitally repairing or reintegrating damaged or decayed elements of an existing asset to hypothesize its original state. Both require rigorous documentation and scholarly transparency. Beyond these technical processes, contemporary models emphasize sustainability and participation. The "preservation-to-participation" continuum posits that digital tools should not only record heritage but also empower communities to engage with, interpret, and sustain it (Najjar *et al.*, 2025; Elrawy, 2025). This aligns with the concept of digital stewardship, which involves ongoing management, updating, and accessibility of digital assets as part of a long-term cultural strategy (El Debuch *et al.*, 2024). Furthermore, integrated models like GIS-based heritage management combine spatial data (from 3D models, maps, surveys) with attribute data (historical information, condition assessments, tourism metrics) to support evidence-based conservation planning, visitor management, and sustainable development (Alawer, 2018; Waheeb *et al.*, 2023). These models collectively argue for a holistic approach where digital preservation is inextricably linked to strategies for access, education, and community benefit.

The Role of VR in Bridging Conservation and Public Engagement

VR acts as a powerful bridging technology, creating a symbiotic loop between the technical demands of conservation and the experiential goals of public engagement. For conservators, VR serves as an advanced analytical and planning tool. Detailed 3D

models derived from laser scanning or photogrammetry provide an immutable digital record of a site's condition at a specific time, essential for monitoring decay (Zhong *et al.*, 2021). These models allow for non-invasive analysis of structural issues, virtual testing of restoration hypotheses, and detailed study of architectural details without risking the original fabric (Pietroni & Ferdani, 2021). For the public, the same high-fidelity digital asset becomes the foundation for an immersive gateway. VR democratizes access by allowing global audiences, students, and individuals with physical disabilities to "visit" sensitive, remote, or otherwise inaccessible sites (Paladini *et al.*, 2019; Selmanović *et al.*, 2020). More profoundly, it can re-contextualize and narrativize heritage. A ruined structure can be visually restored to its heyday; intangible practices like historical ceremonies or craft techniques can be animated and embedded within the virtual space (Liu, 2023; Alaslani, 2024). This transforms heritage from a static object of study into a dynamic, experiential story. By satisfying the rigorous data needs of conservation while providing the emotive, interactive experiences desired by the public, VR creates a vital feedback loop: public interest and understanding fostered through engagement can, in turn, generate greater support and resources for ongoing physical conservation efforts (Zhang *et al.*, 2025).

The Interior Architectural Heritage of Taif City

The interior architectural heritage of Taif City is characterized by distinctive local styles and elements that reflect the region's cultural identity, climate, and social practices. The predominant Hijazi vernacular architecture blends influences from Islamic, Ottoman, and local Hejazi traditions, emphasizing climatic adaptability and social privacy (Al-Zahrani, 2018; Al-Baqmi, 2021). Key interior elements include the iconic Rowshan (projected wooden lattice window), which modulates light and airflow; central courtyards (hosh) that organize family life and provide natural ventilation; and intricate wall finishes such as decorative plasterwork (gypsum carvings) and ornamental murals that showcase local craftsmanship (Alhuseini *et al.*, 2023; Abass *et al.*, 2016). These interiors also feature high ceilings, stone and wood surfaces, and spatial sequences that facilitate social rituals like the majlis (Alsabban & Alotaibi, 2025). However, Taif's heritage faces local preservation challenges, including degradation due to harsh climatic conditions (humidity, temperature fluctuations), urban development pressures, and the fragility of wooden and plaster elements (Waheeb *et al.*, 2023; AlGassim *et al.*, 2024). Furthermore, the intangible heritage associated with these spaces—

such as oral histories, craft techniques, and social practices—remains under-documented and at risk of being lost (Alaslani, 2024; Najjar et al., 2025). These unique aesthetic, spatial, and cultural attributes, combined with pressing preservation needs, make Taif's interior heritage a critical focus for VR-based conservation strategies.

VR Strategies for Preserving Aesthetic Experience High-Fidelity Digital Documentation and 3D Reconstruction

Photogrammetry and Laser Scanning for Accurate Capture

The foundation of any credible virtual heritage experience lies in the accuracy and detail of its digital documentation. Contemporary research underscores the complementary roles of photogrammetry and laser scanning (LiDAR) in capturing the intricate aesthetic qualities of heritage sites. Photogrammetry excels at recording color, texture, and surface reflectance under specific lighting conditions, which is crucial for conveying material authenticity (Zhou & Li, 2024; Zhang et al., 2025). Laser scanning, conversely, provides unparalleled geometric precision and is effective for capturing complex spatial relationships and structural details, even in low-light conditions (Barsanti et al., 2013; Albourae, 2024). For the diverse heritage of Taif, ranging from the ornate wooden latticework of the Rowshan to the expansive stonework of Kaaki Palace, a hybrid approach is recommended. This integrated methodology ensures that both the macro-scale form and the micro-scale texture, essential for aesthetic perception, are digitally preserved (Alhuseini et al., 2023; Sun et al., 2024).

Reconstructing Lost or Damaged Architectural and Artistic Elements

Virtual Reality offers powerful tools for the scholarly reconstruction and restoration of heritage elements that have been lost to time, decay, or damage. The processes of virtual reconstruction and virtual restoration are critical here (Pietroni & Ferdani, 2021). Virtual reconstruction involves building digital models of no-longer-extant structures or past historical phases based on archaeological evidence, historical texts, and iconographic sources. For Taif, this could involve digitally rebuilding earlier phases of Al-Kaaki Palace or visualizing pre-Islamic settlements. Virtual restoration focuses on digitally repairing existing but degraded artifacts or architecture, such as faded murals or eroded stone carvings, to hypothesize their original appearance for study and public appreciation (Liu, 2023). These processes

must be grounded in rigorous research and transparency, clearly distinguishing between evidence-based elements and informed conjecture to maintain scholarly integrity and public trust (Chen et al., 2025).

Sensory Immersion and Multi-Modal Representation

Visual Fidelity: Lighting, Textures, and Materiality

Moving beyond geometric replication, high-fidelity VR must convincingly simulate the visual properties that define a site's aesthetic character. This involves the accurate digital rendering of materiality (e.g., the grain of wood, the polish of stone), textures, and critically, dynamic lighting conditions (Lin et al., 2025). The play of light is a defining aesthetic feature in many Islamic architectural spaces, such as the dappled patterns cast by a Rowshan. Advanced rendering techniques, including physically based rendering (PBR), can simulate how light interacts with different surfaces at various times of day, preserving and communicating these ephemeral qualities (Zhou & Li, 2024). This attention to visual fidelity is paramount for evoking the atmosphere (*genius loci*) and emotional response associated with the physical site (Zhang et al., 2023).

Integrating Auditory Elements (Soundscapes, Oral Histories)

Sound is a fundamental, yet often overlooked, component of the heritage aesthetic. VR allows for the integration of spatialized audio to recreate the acoustic signature of a place, be it the echo in a historic courtyard, the sound of a nearby souq, or the call to prayer (Alaslani, 2024; Cecotti, 2022). Furthermore, embedding oral histories, traditional music, or narrated stories within the VR environment enriches the narrative context and supports the preservation of intangible heritage (Selmanović et al., 2020). For Taif, incorporating recordings of local narratives about historic events or the ambient sounds of its rose farms could deepen the sense of cultural presence and immersion.

Haptic and Olfactory Feedback: Emerging Possibilities

While still emergent, haptic (touch) and olfactory (smell) feedback represent the frontier of multi-sensory VR. Haptic devices can simulate the tactile sensation of touching a textured wall or a traditional fabric, enhancing the sense of physical presence (Rani et al., 2023). Olfactory cues, such as the scent of roses for which Taif is famous or the smell of aged wood, could trigger powerful mnemonic and emotional connections (Lin et al., 2025). Although technical and

practical challenges remain, these modalities offer profound potential for creating deeply immersive and memorable aesthetic experiences that engage the full spectrum of human perception.

Contextual and Narrative Reconstruction Recreating Historical Atmospheres and Spatial Narratives

A key strength of VR is its ability to reconstruct not just objects, but the lived atmosphere of a place in its historical context. This involves designing environments that convey a sense of life and activity—populating a virtual souq with digital avatars, showing a historic palace furnished as it once was, or simulating the movement of people through a space (Champion & Foka, 2020; El Debuch *et al.*, 2024). This contextual layer transforms a static model into a dynamic, believable world. It allows users to understand spatial narratives—how rooms connect, how vistas unfold, and how architecture orchestrated social and ceremonial life—which is central to appreciating the cultural logic of heritage sites like Taif's traditional courtyard houses (Abass *et al.*, 2016).

Embedding Intangible Heritage (Stories, Rituals, Traditions)

VR serves as a vital medium for safeguarding and presenting intangible cultural heritage (ICH). By embedding interactive narratives, animated sequences, or virtual performances, VR can illustrate traditional crafts, rituals, festivals, and oral traditions that are inextricably linked to a physical site (Selmanović *et al.*, 2020; Alaslani, 2024). For instance, a VR experience of a Taif heritage house could include a vignette demonstrating the social rituals of coffee preparation (qahwa) in the majlis, or an animation showing the craftsmanship involved in creating a Rowshan. This approach ensures that the living culture, not just the inert structures, is passed on to future generations (Najjar *et al.*, 2025).

VR for the Preservation and Presentation of Interior Heritage Spaces

The interior spaces of cultural heritage sites represent the most intimate and culturally significant layer of architectural heritage, where spatial design, materiality, light, and social practices converge to create rich aesthetic and emotional experiences (Albourae, 2024; Abass *et al.*, 2016). In the context of Taif City, interiors such as those in Shubra Palace, Al-Dahlawi Palace, and traditional courtyard houses are not merely functional enclosures but embody the cultural identity, climatic adaptability, and social rituals of the Hijaz region. Preserving these interiors through Virtual Reality requires a focused, multi-sensory strategy that

addresses their unique aesthetic, spatial, and experiential qualities while ensuring equitable access and community involvement (Elrawy, 2025; Najjar *et al.*, 2025).

The Cultural and Aesthetic Significance of Taif's Interior Spaces

Interior spaces in Taif's heritage architecture are defined by several distinctive features that contribute to their aesthetic and cultural value. Courtyard-centered layouts (hosh) facilitate natural ventilation, privacy, and family-oriented social interaction, reflecting a deep understanding of local climate and social norms (Abass *et al.*, 2016; Al-Zamil, 2018). Elements such as the Rowshan (projected wooden window), carved wooden screens (jalīs), decorative plasterwork, and ornamental murals exemplify local craftsmanship and aesthetic principles (Alhuseini *et al.*, 2023). The interplay of light and shadow, acoustic properties of high-ceilinged rooms, tactile surfaces of stone and wood, and even olfactory elements such as rose water or aged wood contribute to a holistic sensory experience (Lin *et al.*, 2025; Sun *et al.*, 2024). Interiors historically hosted social gatherings (majlis), coffee ceremonies (qahwa), and family rituals, embedding these spaces with lived cultural meaning (Alsabban & Alotaibi, 2025; Alaslani, 2024).

Challenges in Preserving Interior Heritage Spaces

Interiors are particularly vulnerable to several preservation challenges:

1. Exposure to humidity, temperature fluctuations, and insect activity threatens wooden elements, wall finishes, and structural integrity (Waheeb *et al.*, 2023).
2. Fragile or restricted interiors limit physical access for visitors, scholars, and persons with disabilities, while also hindering the documentation of sensory qualities such as acoustics and ambient light (Paladini *et al.*, 2019; Selmanović *et al.*, 2020).
3. As living practices evolve, the social and ritual uses of interior spaces risk fading from collective memory (Alaslani, 2024).
4. Conventional 2D drawings and photographs often fail to capture the volumetric, textural, and atmospheric complexity of interiors (Barsanti *et al.*, 2013).

VR Strategies for Interior Documentation and Immersive Reconstruction

VR Strategies for Interior Documentation and Immersive Reconstruction involve a multi-layered approach to preserve and present heritage interiors. High-fidelity digital documentation integrates LiDAR

and photogrammetry to capture both geometric precision and material authenticity, while advanced lighting capture techniques preserve ephemeral atmospheric qualities. Immersive reconstruction employs volumetric modeling and Physically Based Rendering to create spatially and materially accurate environments, enhanced with spatial audio and interactive narrative layers that embed intangible cultural practices. Contextual layering is achieved through evidence-based virtual restoration and atmospheric simulations that populate spaces with period-accurate elements, conveying lived historical narratives and spatial evolution.

Ethical, Authenticity, and Community Considerations

Ethical VR development requires transparency in reconstruction, distinguishing between original and conjectural elements (Pietroni & Ferdani, 2021). Community co-creation with local historians and artisans ensures cultural authenticity and fosters local stewardship (Najjar et al., 2025; Elrawy, 2025).

Case Application: A VR Proposal for a Taif Courtyard House

A proposed VR pilot project for a Taif courtyard house outlines a comprehensive workflow beginning with integrated LiDAR and photogrammetric documentation to capture architectural details like the Rowshan and wall textures. This is followed by the development of a Physically Based Rendering (PBR) 3D model that accurately simulates dynamic lighting and materiality. The experience is enriched through sensory and narrative integration, incorporating spatial audio such as fountain sounds and oral histories, alongside interactive storytelling linked to household objects. To ensure broad accessibility, the project will deploy both a high-immersion VR installation for museums and a web-based mobile experience featuring inclusive navigation. Finally, an evaluation phase will assess user engagement, emotional response, and learning outcomes to guide iterative refinements (Lin et al., 2025; Alsabban & Alotaibi, 2025).

Integration with Brother Preservation and Tourism Strategies

Interior VR models can be linked with GIS-based heritage systems for sustainable tourism planning (Alawer, 2018). Augmented Reality (AR) applications can enhance on-site visits by overlaying historical information onto physical spaces (Hussein & Al Ali, 2025). These efforts align with Saudi Vision 2030 goals for cultural tourism and digital innovation (Alkhaliel, 2022).

VR Strategies for Providing and Enhancing Public Access

Remote Accessibility and Virtual Tourism Overcoming Geographic and Physical Barriers

VR is a powerful democratizing tool that fundamentally redefines access to heritage. It eliminates geographical distance, allowing global audiences to "visit" remote, fragile, or politically inaccessible sites (Paladini et al., 2019; Zhong et al., 2021). It also overcomes physical barriers for individuals with mobility impairments, enabling them to explore multi-story buildings or rugged archaeological sites that would be challenging in reality. Projects like UNESCO's "Dive into Heritage" exemplify this global reach, a trend directly aligned with Saudi Vision 2030's goals of expanding cultural tourism (UNESCO, 2025; Alkhaliel, 2022).

VR for Pre-Visit Engagement and Post-Visit Reflection

VR applications can extend the heritage visit beyond the physical encounter. As a pre-visit tool, VR can prepare tourists by familiarizing them with a site's layout, history, and significance, thereby enhancing the quality and depth of their eventual in-person experience (Alkhaliel, 2022). As a post-visit resource, VR allows for reflective exploration, revisiting details missed during the physical visit, or accessing additional layers of historical information and reconstruction, solidifying learning and memory (Zhang et al., 2025).

Inclusive and Adaptive Design for Diverse Audiences

Access for Persons with Disabilities

Inclusive design principles must be integrated into VR heritage development. This includes providing alternative navigation schemes (e.g., teleportation, guided pathways), customizable interfaces with adjustable text sizes and contrast, audio descriptions for the visually impaired, and subtitle options for auditory content (Paladini et al., 2019; Selmanović et al., 2020). Ensuring VR experiences are compatible with a range of hardware, from high-end headsets to more accessible smartphone-based VR, also broadens access across socioeconomic groups.

Customizable Experiences for Different Learning Styles and Age Groups

Effective heritage VR should cater to diverse user profiles. This can be achieved through adaptive storytelling and customizable information layers. A child might engage with a gamified quest to find architectural features, while a scholar might access detailed metadata from 3D scans. Families might

follow a narrative tour, whereas students might engage with interactive quizzes or reconstruction timelines (Champion & Foka, 2020; Rani *et al.*, 2023). A user-centered design approach, as advocated by Alsabban & Alotaibi (2025), is essential to develop experiences that are both engaging and educationally effective for all.

Educational and Interpretive Applications

VR in Formal and Informal Heritage Education

VR is transforming heritage education by providing immersive, experiential learning environments. In formal settings, it can be integrated into history, art, and architecture curricula, allowing students to conduct virtual field trips to sites like Taif from their classrooms (Zhong *et al.*, 2021). In informal settings, such as museums or online platforms, VR experiences can foster self-directed learning and spark public interest in heritage conservation (El Debuch *et al.*, 2024). The key is to align the VR experience with clear learning outcomes, using immersion to foster empathy and deeper historical understanding.

Gamification and Interactive Learning in Heritage Contexts

Gamification, the application of game-design elements—proves highly effective in increasing engagement and knowledge retention. In heritage VR, this can involve puzzle-solving to "restore" a virtual artifact, scavenger hunts to discover historical facts, or role-playing scenarios that place the user in a historical context (Champion & Foka, 2020; Liu, 2023). For example, a user might "assist" a virtual craftsman in assembling a Rowshan, learning about its components and symbolism through interactive tasks. Such approaches transform passive observation into active participation, making the exploration of heritage both educational and entertaining (Rani *et al.*, 2023).

Case Study Synthesis: Applications and Potential in Taif City

Overview of Key Heritage Sites in Taif (e.g., Shubra Palace, Al-Dahlawi Palace, Historic Souqs)

Taif City possesses a layered and diverse heritage landscape that reflects its historical significance as a cultural, agricultural, and political hub in the Hijaz region. Key sites include:

Shubra Palace: Built in the early 20th century, this historic palace is an architectural landmark that blends Ottoman and local Hijazi styles, featuring ornate wooden façades and spacious courtyards. It serves as a regional museum, but its structural and aesthetic details require careful preservation (Al-Zahrani, 2018; Al-Baqmi, 2021).

Al-Dahlawi Palace: Al-Dahlawi Palace is a significant heritage site in Taif, founded by the Al-Dahlawi family in 1315 AH (1897 CE). It exemplifies Hejazi architecture with Roman and Islamic influences, serving as a testament to the city's history (Al-Zahrani, 2018; Saudi Heritage Commission, 2021). Built in phases by Abdullah and Obaidullah Al-Dahlawi, the palace complex features three interconnected buildings with approximately 50 rooms, large windows, Roman columns, and detailed woodwork (Al-Ghamdi, 2019). Constructed from local stone, mud, and juniper, it includes three diwans (reception halls) and a courtyard with a well (Historical Taif Project, 2020). The palace has hosted royalty, including King Fahd, and remains a residence for the family while functioning as an open-air museum that supports cultural tourism (Al-Sudairi, 2022; Ministry of Culture, 2023).

Historic Souqs (e.g., Souq Al-Sagha, Souq Al-Haraj): These traditional markets are centers of intangible heritage, where craftsmanship, trade, and social interaction converge. Their narrow alleys, shaded arcades, and vernacular architectural elements such as the Rowshan create a distinct sensory and spatial experience (Alhuseini *et al.*, 2023; Al-Baqmi, 2021).

Inventory of Key Heritage Sites in Taif for VR Application

The following table presents a curated selection of Taif's heritage buildings, chosen for their architectural significance, interior richness, and potential for VR-based preservation and access.

Table 1: Taif's Heritage Buildings for Analysis

Building/Site Name	Reason for Selection	Key Interior Features	VR Potential
Shubra Palace	Iconic landmark blending Ottoman & Hijazi styles; functions as a regional museum but has restricted fragile interiors.	Ornate wooden façades (Rowshan), spacious courtyards, high-ceilinged rooms, decorative plasterwork, historical spatial sequences.	High-immersion reconstruction of historical periods; virtual restoration of decorative details; interactive narrative tours.
Al-Dahlawi Palace	Significant Hejazi palace with Roman/Islamic influences; serves as an open-air museum but has limited interior access.	Approximately 50 rooms, large windows, Roman columns, detailed woodwork, three diwans (reception halls), central courtyard with a well.	Virtual exploration of multi-room layout; simulation of historical gatherings; spatial audio integration of oral histories.

Al-Kaaki Palace	Historic Ottoman-era structure representing Taif's layered past; partially ruined and geographically remote.	Stonework, arched doorways, traditional spatial organization, remnants of decorative interior elements.	Virtual reconstruction of lost phases; digital restoration of degraded surfaces; contextualization within historical narrative.
Traditional Courtyard Houses	Exemplify vernacular Hijazi domestic architecture; reflect climate-responsive design and family-oriented social life.	Central courtyard (hosh), Rowshan windows, carved wooden screens (jalīs), tactile stone/wood surfaces, majlis spaces.	Multi-sensory simulation of domestic life; embedding of intangible practices (coffee rituals); demonstration of passive cooling strategies.
Historic Souqs (e.g., Souq Al-Sagha)	Centers of intangible heritage and vernacular commercial architecture; at risk of losing traditional atmosphere.	Narrow alleys, shaded arcades, Rowshan-adorned façades, ambient soundscapes of trade and craft activities.	Recreation of historical market atmosphere; virtual demonstrations of traditional crafts (e.g., rose distillation, metalwork); gamified exploration.

Analysis of Current Digital/VR Initiatives in the Region

The analysis of current digital and VR initiatives in the region reveals that there is, to date, limited evidence of comprehensive, publicly accessible VR projects specifically dedicated to Taif's heritage. However, a foundational ecosystem exists through several related digital efforts. These include GIS-based documentation for urban and heritage planning, which provides a valuable spatial data layer for future VR integration; national precedents such as VR tourism case studies and UNESCO-supported digital platforms that demonstrate available technical and institutional capacity; and academic research on Taif's architectural evolution and user-centered design, which offers critical data and theoretical insights. Additionally, while some local pilot projects involving basic 3D scanning exist, they typically remain as isolated digital archives rather than being developed into integrated, immersive VR experiences for the public.

Identifying Specific Aesthetic and Access Challenges for Taif's Sites

Taif's heritage faces unique challenges that VR strategies must address:

1. Aesthetic Challenges:

- The interplay of light through interior Rowshan screens and the texture of local wall, ceiling, stone, and wood materials are central to the aesthetic experience but are difficult to capture and replicate digitally without high-fidelity multispectral recording (Zhou & Li, 2024).
- Traditional crafts associated with interior elements (e.g., woodworking for doors and ceilings, gypsum carving for walls), along with related oral histories and social practices, are not systematically documented and are vulnerable to being lost (Alaslani, 2024).
- Exposure to harsh climatic conditions and urban encroachment threatens the physical

integrity and aesthetic qualities of interior surfaces and broader heritage sites (Waheeb et al., 2023).

- Many heritage interiors exist in isolated or altered urban settings, making it difficult for visitors to appreciate their original spatial and historical context (Al-Baqmi, 2021).

2. Access Challenges:

- The interior spaces of many sites are fragile or have restricted access. Furthermore, several sites are remote or have limited infrastructure, restricting physical access for tourists, scholars, and persons with disabilities (Paladini et al., 2019).
- Taif's popularity as a summer destination leads to seasonal overcrowding, while off-peak periods see reduced engagement, creating an uneven visitor experience (AlGassim et al., 2024).
- Many sites lack multilingual, engaging, or interactive educational materials, reducing their appeal to younger and international audiences (Champion & Foka, 2020).
- High travel costs and a lack of affordable, tailored tourism packages limit access for domestic and regional visitors (Alkhaliel, 2022).

Proposed VR Strategy Framework Tailored for Taif's Heritage Context

Drawing from global best practices and aligned with Saudi Vision 2030, a multi-phase VR strategy framework is proposed for Taif:

Phase 1: Collaborative Digital Documentation & Asset Creation

Hybrid Scanning Campaigns: Deploy integrated LiDAR and photogrammetry teams to capture key sites (e.g., Shubra Palace interior) with emphasis on material texture, color, and lighting conditions (Barsanti et al., 2013; Sun et al., 2024). **Intangible Heritage Recording:** Conduct ethnographic fieldwork to record oral histories, craft

demonstrations (e.g., rose distillation, woodworking for Rowshan), and ambient soundscapes of historic souqs (Selmanović *et al.*, 2020; Alaslani, 2024). Community Co-Creation Workshops: Engage local historians, artisans, and residents in validating digital reconstructions and contributing narratives, ensuring cultural authenticity and community buy-in (Najjar *et al.*, 2025; Elrawy, 2025).

Phase 2: Multi-Tiered VR Experience Development

- Tier 1: High-Immersion VR for Museums & Visitors Centers: Develop full VR experiences for placement in Shubra Palace Museum and Taif Visitor Center, allowing users to explore reconstructed historical phases of key sites with multisensory feedback (haptic, spatial audio) (Cecotti, 2022; Lin *et al.*, 2025).
- Tier 2: Mobile & Web-Based Accessible VR: Create lightweight, browser-compatible VR tours for global remote access, optimized for smartphones and low-bandwidth environments, with inclusive features like audio descriptions and adjustable navigation (Paladini *et al.*, 2019).
- Tier 3: Augmented Reality (AR) On-Site Enhancements: Develop AR applications that overlay historical information, reconstructions, and narratives onto the physical sites via mobile devices, enhancing the in-person visit without intrusive infrastructure (Hussein & Al Ali, 2025; Shih *et al.*, 2020).

Phase 3: Integration with Education & Sustainable Tourism

Curriculum Integration: Partner with the Ministry of Education to embed VR experiences of Taif's heritage into national history and social studies curricula, complete with lesson plans and interactive assignments (Zhong *et al.*, 2021). Gamified Tourism Packages: Design VR/AR-enhanced tourist itineraries that include gamified challenges (e.g., "solve the mystery of the palace," "collect virtual rose essences") to encourage exploration and extended stays (Champion & Foka, 2020; Liu, 2023). Digital Stewardship Portal: Establish a Taif Heritage Digital Portal, managed by local authorities, to serve as a central repository for all digital assets, ensuring long-term preservation, updates, and open access for research (El Debuch *et al.*, 2024; Najjar *et al.*, 2025).

Phase 4: Monitoring, Evaluation, and Iteration

User Experience (UX) Feedback Loops:

Implement analytics and feedback mechanisms within VR applications to gather data on user engagement, emotional response, and learning outcomes, informing iterative improvements (Alsabban & Alotaibi, 2025; Lin *et al.*, 2025). Impact Assessment: Regularly evaluate the strategy's impact on tourist numbers, educational outcomes, community pride, and the physical conservation of sites, using both qualitative and quantitative metrics (Zhang *et al.*, 2025; Waheeb *et al.*, 2023). This framework positions VR not as a replacement for physical heritage, but as a complementary tool that enhances preservation, access, and meaningful engagement with Taif's unique cultural legacy.

Critical Analysis of Challenges and Limitations Technical and Infrastructural Challenges Cost, Expertise, and Technological Requirements

The implementation of high-fidelity VR for heritage preservation entails significant financial and technical investments. The costs associated with advanced 3D documentation tools—such as terrestrial laser scanners (LiDAR) and high-resolution photogrammetry setups—as well as the computational resources needed for processing and rendering complex models, can be prohibitive for local authorities (Barsanti *et al.*, 2013; Albourae, 2024). Additionally, there is a scarcity of specialized expertise in the Kingdom of Saudi Arabia that combines heritage conservation, 3D digital documentation, and immersive experience design (Alkhaliel, 2022). The lack of standardized workflows and interoperable platforms further complicates large-scale deployment. For Taif, these challenges are compounded by the need for climate-adapted hardware and the logistical difficulties of scanning remote or fragile sites. Without sustained funding, training programs, and technological infrastructure, the risk of creating low-quality or unsustainable digital assets is high.

Issues of Digital Accuracy and Authenticity

Achieving digital accuracy that faithfully represents the aesthetic and material qualities of heritage sites is a persistent challenge. While photogrammetry and LiDAR can capture geometric and textural data, they may not fully reproduce subtle qualities such as patina, weathering effects, or the nuanced interplay of light in spaces like a Rowshan-lit room (Zhou & Li, 2024). Furthermore, the process of virtual reconstruction or restoration involves interpretive decisions that can affect perceived authenticity. There is a fine line between evidence-based reconstruction and speculative modeling, which may inadvertently alter the historical narrative or aesthetic intent (Pietroni &

Ferdani, 2021). For Taif, where many sites have undergone modifications or are partially ruined, ensuring that digital reconstructions are transparently documented and peer-reviewed is essential to maintain scholarly and cultural integrity (Chen et al., 2025).

Ethical and Cultural Considerations

Balancing Reconstruction with Historical Integrity

VR enables the vivid reconstruction of lost or altered heritage, but this power must be exercised with ethical caution. Over-reconstruction or the creation of idealized versions of the past can lead to a “Disneyfication” of heritage, where sanitized, entertaining representations replace historical complexity and authenticity (Zhao, 2021). In the context of Taif, reconstructing Ottoman-era palaces or pre-Islamic settlements must be grounded in rigorous archaeological and historical research, with clear visual cues distinguishing between extant, reconstructed, and hypothetical elements (Pietroni & Ferdani, 2021). This balance is crucial to avoid misleading the public and to respect the site’s true historical narrative.

Community Involvement and Avoiding Digital Colonialism

A critical ethical concern is the risk of “digital colonialism,” where external experts or institutions control the digitization, interpretation, and dissemination of local heritage without meaningful community involvement (Elrawy, 2025; Najjar et al., 2025). For Taif, the intangible heritage associated with sites—such as oral histories, traditional crafts, and social practices—is deeply embedded in local communities. Excluding these communities from the VR development process can lead to misrepresentation, cultural appropriation, or the erosion of local ownership (Alaslani, 2024). Ethical VR projects must adopt participatory models, engaging local historians, artisans, and residents as co-creators and validators to ensure cultural sensitivity, relevance, and sustainable stewardship (Selmanović et al., 2020).

User Experience and Psychological Impact

The "Aura" of the Original vs. the Virtual Replica

Walter Benjamin’s concept of the “aura”—the unique presence and authenticity of an original artwork or site—poses a philosophical and experiential challenge for VR heritage. While VR can provide immersive access, it cannot fully replicate the aura of physically being in a historic space, with its tangible materiality, ambient atmosphere, and lived context (Zhang et al., 2023). For some users, especially purists or traditionalists, the virtual

experience may feel sterile or insufficiently evocative. Therefore, VR should be framed not as a replacement, but as a complementary medium that offers different kinds of engagement—such as contextual education, remote access, or interactive storytelling—without claiming to fully substitute the authentic encounter (Lin et al., 2025).

Potential for Simulation Sickness and Accessibility Barriers

From a practical UX perspective, VR can induce simulation sickness (cybersickness) in some users due to latency, visual-vestibular conflict, or prolonged use (Rani et al., 2023). This poses a barrier to inclusive access, particularly for older adults or individuals prone to motion sensitivity. Additionally, while VR has the potential to enhance accessibility for people with disabilities, poorly designed experiences can create new barriers—such as complex navigation, lack of alternative input methods, or insufficient audio descriptions for the visually impaired (Paladini et al., 2019). For Taif’s diverse audience, including international tourists and local families, VR applications must undergo rigorous usability testing and adhere to inclusive design principles to ensure they are comfortable, intuitive, and accessible to all (Alsabban & Alotaibi, 2025).

Synthesis, Future Directions, and Recommendations

Synthesis of Effective VR Strategies for Aesthetic Preservation and Access

This review identifies several core strategies that are effective for preserving aesthetic experience and enhancing access through VR:

- **Integrated Documentation** for comprehensive digital capture of tangible interior elements.
- **Multi-Sensory Design** to recreate the interior ambiance.
- **Contextual and Narrative Embedding** to illustrate the use and significance of heritage interiors.
- **Multi-Tiered Access Models** for exploring interior spaces.
- **Community Co-Creation** to ensure authenticity of interior narratives and craftsmanship.

Integrating VR with Other Technologies (AI, IoT, AR)

The future of virtual heritage lies in the convergence of VR with other emerging technologies:

1. Artificial Intelligence (AI):

AI can automate aspects of 3D model processing, enhance image resolution, generate realistic textures, or create intelligent virtual guides that adapt narratives to user interests (Zhang *et al.*, 2025). AI-driven analytics can also provide insights into user behavior and learning outcomes within VR experiences.

2. Internet of Things (IoT):

On-site IoT sensors can monitor environmental conditions (humidity, temperature, structural movement) at physical heritage sites. This real-time data can be linked to digital twins in VR, allowing conservators to visualize and analyze site health remotely (Waheeb *et al.*, 2023).

3. Augmented Reality (AR):

As a companion to VR, AR can enrich the physical visit by overlaying historical information, reconstructions, or animations onto the real-world site via smartphones or AR glasses. This blended approach supports experiential learning and contextual understanding without isolating the user from the actual environment (Hussein & Al Ali, 2025; Shih *et al.*, 2020).

4. Metaverse Platforms

Emerging metaverse ecosystems offer opportunities to place Taif's heritage within interconnected virtual worlds, enabling social interactions, virtual events, and persistent digital tourism experiences that extend beyond isolated VR applications (Alkhaliel, 2022).

Policy and Collaborative Recommendations for Stakeholders in Taif

To realize the potential of VR for Taif's interior architectural heritage, coordinated action is needed across multiple stakeholders, with specific recommendations for Taif:

- ❖ For Governmental Bodies (e.g., Saudi Ministry of Culture, Taif Municipality, Taif Historic Area Preservation Authority):
 1. Launch the "Taif Digital Heritage Initiative" as a flagship pilot project under Vision 2030, focusing initially on high-priority sites like Shubra Palace and Al-Dahlawi Palace, with dedicated funding, timelines, and clear key performance indicators (KPIs) for digital preservation and public engagement.
 2. Establish Taif-specific digital heritage guidelines for the documentation, reconstruction, and accessibility of interior architectural elements, ensuring consistency, quality, and interoperability across projects.
 3. Create a "Taif Heritage VR Fund" and partner with local universities (e.g., Taif University) and technology companies to

build local capacity in 3D documentation, VR development, and heritage informatics.

- ❖ For Academic and Research Institutions (e.g., Taif University, College of Design and Applied Arts):
 1. Launch an interdisciplinary research program focusing on the digital preservation of Hijazi interior architecture and Taif's intangible heritage, producing case studies, technical pipelines, and evaluation frameworks.
 2. Offer specialized training workshops and certification programs in 3D laser scanning, photogrammetry, and immersive experience design for students, professionals, and local community members.
 3. Conduct longitudinal impact studies on the effectiveness of VR experiences in enhancing tourist engagement, educational outcomes, and conservation awareness specific to Taif's heritage sites.
 - ❖ For Local Communities and NGOs in Taif:
 1. Form a "Taif Community Heritage Council" comprising local historians, artisans, elders, and residents to guide VR project development, validate cultural content, and contribute oral histories and traditional knowledge.
 2. Organize community co-creation and digital literacy workshops to empower local stakeholders to actively participate in, benefit from, and sustain digital heritage projects, ensuring cultural authenticity and local ownership.
 - ❖ For Private Sector and Tourism Operators in Taif:
 1. Invest in VR/AR visitor centers and mobile applications as part of enhanced tourism packages for Taif, offering tiered experiences (high-immersion, mobile, AR) at key sites like Shubra Palace and historic souqs.
 2. Collaborate with content creators to develop gamified and narrative-driven VR experiences that highlight Taif's unique interior heritage, targeting diverse audiences including families, students, and international tourists.
- ### 1.1. Suggested Framework for Future Research and Pilot Projects
- To advance both theory and practice, future work should focus on:
1. "Virtual Shubra Palace - A Multi-Sensory Journey"
 2. Create a high-fidelity VR experience that allows users to explore Shubra Palace across different historical periods, with integrated soundscapes, narrated histories, and interactive

- elements highlighting architectural details like the Rowshan.
3. Study user emotional response, learning retention, and perceptions of authenticity compared to a physical visit.
 4. A publicly accessible VR installation at the palace, a web-based tour, and a scholarly publication evaluating the methodology and impact.
 5. Explore the use of AI for automated damage detection in digital models and machine learning for personalized storytelling in VR.
 6. Develop and test participatory models for community-based digital heritage in the Saudi context.
 7. Compare the effectiveness of VR strategies for heritage preservation in Taif with similar initiatives in other arid region or Islamic heritage contexts.
 8. Establish a Taif Digital Heritage Lab as a hub for training, innovation, and collaboration between academia, government, and industry.
 9. Implement a digital stewardship plan that includes regular updates, data migration strategies, and open-access policies to ensure the long-term viability of digital assets.
- the genius loci of heritage interiors (Zhang et al., 2023; Lin et al., 2025).
3. VR democratizes access to fragile or restricted interior spaces by overcoming geographic, physical, and socioeconomic barriers, while also serving as a tool for education, virtual tourism, and community participation (Paladini et al., 2019; Selmanović et al., 2020).
 4. The proposed multi-phase VR strategy for Taif city aligns with the Kingdom of Saudi Arabia's Vision 2030 goals for cultural tourism, digital innovation, and sustainable development (Alkhalil, 2022; UNESCO, 2025).
- 1.2. Key Findings for Taif's Interior Architectural Heritage
- This review yields several findings specifically relevant to the preservation of Taif's interior architectural heritage:
- Taif's heritage interiors are defined by distinctive elements such as the Rowshan, courtyard-centered layouts (*hosh*), and intricate plasterwork, which collectively create a multisensory aesthetic experience deeply tied to local climate and culture (Alhuseini et al., 2023; Abass et al., 2016).
 - The interior wooden elements, wall finishes, and intangible practices associated with Taif's heritage are particularly vulnerable to climatic degradation, urban pressures, and fading community memory, necessitating urgent digital documentation (Waheeb et al., 2023; Alaslani, 2024).
 - Sites like Shubra Palace and traditional courtyard houses possess clear spatial narratives, rich materiality, and cultural stories that make them ideal candidates for immersive VR reconstruction, offering opportunities for virtual restoration, sensory simulation, and interactive learning (Zhou & Li, 2024; Lin et al., 2025).
 - Tailoring VR strategies to Taif's specific heritage context aligns directly with Saudi Vision 2030 goals for cultural tourism, technological innovation, and sustainable heritage stewardship, positioning the city as a model for digital heritage within the Kingdom (Alkhalil, 2022; UNESCO, 2025).

Conclusion

This literature review has synthesized contemporary research to outline a comprehensive framework for employing Virtual Reality (VR) in preserving the aesthetic experience and enhancing accessibility to heritage sites in Taif City. Key findings include:

1. The integration of high-fidelity digital documentation methods, such as hybrid LiDAR and photogrammetry, is essential for accurately capturing the aesthetic and spatial qualities of Taif's interior architectural heritage, from intricate Rowshan woodwork to expansive decorated ceilings (Barsanti et al., 2013; Zhou & Li, 2024).
2. VR moves beyond geometric replication to simulate multisensory experiences, visual, auditory, and contextual, that are central to

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