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Transforming Interpretation of Heritage Sites with AR and VR – A Case of Wooden Temples of Chamba, Himachal Pradesh (India)

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Abstract:
As digital innovation redefines user experience and engagement, Augmented Reality (AR) and Virtual Reality (VR) emerge as compelling mediums for heritage interpretation, offering new avenues to immerse audiences in both tangible and intangible dimensions of cultural heritage. This paper explores the potential of VR in interpreting the oldest surviving wooden temples, dating back to the 7th century, from the Chamba district of Himachal Pradesh in India, specifically the *Lakshana Devi* Temple in *Bharmour* and the *Shakti Devi* Temple *in Chhatrari*. The research follows a qualitative-interpretive research design, built upon a mixed-method case study approach to explore the role of digital documentation and immersive storytelling in interpreting the intricate Post-*Gupta*, *Gandhara* Style, and *Kashmiri* Style wood carvings and the *Pahari* style Murals within the ancient wooden temples of Chamba. Crafted from indigenous *deodar* wood and adorned with intricate wood carvings, these temples embody a unique Himalayan architectural tradition renowned for its seismic resilience and rich cultural narratives. Through photogrammetry and digital documentation, annotated 3D models are created to facilitate immersive storytelling grounded in the associated narratives, ritualistic traditions, and local belief systems. This research proposes an AR and VR-driven framework that emphasizes the importance of narratives in the interpretation and conservation of heritage through digital storytelling and festival and ritual simulation. It highlights a gap in immersive storytelling that engages users both emotionally and cognitively, arguing that AR-VR, when employed thoughtfully, can preserve not just the form but the essence of heritage sites, reinforcing their relevance for both local communities and global audiences.

1. Introduction

Heritage Interpretation serves as a powerful tool for education and lifelong learning, fostering cultural appreciation, intercultural dialogue, and inclusive engagement. Effective interpretation should convey the interconnectedness of tangible and intangible heritage while being inclusive, accessible, and respectful of authentic narratives (ICOMOS 2021). Heritage conservation is essentially 'a communication act' (ICOMOS 2008), that is, the inheritance and transmission of heritage value. Therefore, as an activity aimed at raising public awareness and improving the public's understanding of cultural heritage sites (interpretation) and the planned dissemination of heritage contents at cultural heritage sites (presentation), the interpretation and presentation of heritage have always been regarded as one of the critical missions in the national and international protection of cultural and natural heritage and as the essential component in the process of heritage conservation (UNESCO 1972; ICOMOS 2002; 2008; 2021).

Cultural heritage sites in India represent a diverse array of historical, architectural, and artistic treasures that chronicle the country's rich and storied past. However, the preservation of these invaluable assets is increasingly challenged by factors such as urbanization, environmental degradation, and inadequate funding. In response to these challenges, the adoption of digital preservation methods has emerged as a promising strategy to document, conserve, and disseminate cultural heritage resources (Sabarirajan A et al., 2024). The digital recording of Cultural Heritage is an essential step in understanding and conserving the value of the memory of the past, creating an exact digital record for the future, providing a means to educate, skill, and communicate the knowledge and value of the tangible objects to the society (Ioannides & Patias, 2023).

Augmented Reality (AR), aimed at integrating the virtual and real worlds in a consistent visual perception, has been utilized in various instances within the cultural heritage field—for archaeologists as a tool of assessment; for tourists to gain a better understanding of a site; and for museum stakeholders to plan and educate (Bekele, Pierdicca, Frontoni, Malinverni & Gain, 2018). Virtual Reality (VR) technologies have evolved from a niche innovation into a transformative tool within the entertainment and cultural sectors. Their capacity to construct immersive and interactive environments has increasingly positioned them as valuable assets in cultural heritage research and interpretation (Bianconi, Filippucci, Cornacchini, Meschini, & Mommi, 2023).

Both AR and VR have emerged as powerful tools to interpret; re-interpret; present; and, re-present the multilayered narratives of heritage sites. By creating immersive, interactive experiences, these methods allow museums and cultural institutions to go beyond static displays, offering enriched and contextualized insights that reveal the intricate interplay of historical events, architectural evolution, and cultural symbolism. Although AR-VR has evolved as a powerful tool in heritage documentation and interpretation worldwide, their applications within the Indian temple context remain limited, particularly when it comes to narrative-focused heritage experiences, especially non-literary narratives, such as, carvings and paintings.

Many current AR-VR projects focus primarily on architectural reconstruction and the visual representation of heritage structures. While they effectively create engaging, educational, and emotional user experiences, they often overlook the important intangible aspects, such as oral histories, ritual practices, and embedded narratives, which are essential for understanding the values and significance of cultural heritage. This research highlights a gap in immersive storytelling that engages users both emotionally and cognitively, proposing that AR-VR, when employed thoughtfully, can preserve not just the form but the essence of heritage sites.

1.1 Contextual study: Case of Wooden Temples of Chamba

The Himalayan region centered around Chamba, now in Himachal Pradesh, was historically an independent kingdom until it joined the Indian Union. Its geographic isolation allowed it to maintain a degree of autonomy, even resisting Mughal invasions. This political continuity contributed to the preservation of a rich and diverse artistic and documentary heritage, which remains unique in northern India. Chamba lies within the *Ravi* River basin, a region of significant geographical and cultural importance. The river is referred to in the *Rigveda* as *Parusṇi* and is identified in Greek texts as *Hydraotes.* In classical Sanskrit literature, it is known as *Iravati,* meaning "the Refreshing One" (Voghel 1911). The *Ravi* originates in the *Bara Bhangal* region, a high-altitude cluster of mountains located southeast of the current Himachal Pradesh boundary. Among its important tributaries is the *Budhal* River, which joins the Ravi from the northeast (Hutchison and Voghel 1933; Goetz 1955).

Bharmour, situated along the *Budhal* at an elevation of approximately 2,000 meters (Figure 1), is the town historically known as *Brahmapura*, or the "City of *Brahma*"—a nomenclature that reflects its early role as a center of Brahmanical culture and governance. *Bharmour* functioned as the capital of the Chamba kingdom until the early tenth century CE when King *Sahilavarman* relocated the royal seat to Chamba, situated approximately seventy kilometers downstream along the Ravi (Goetz 1955; 1969).

Figure 1. Location of *Bharmour* and *Chhatrari* in the Chamba district of Himachal Pradesh in India.

Despite its peripheral location, Chamba was not culturally isolated. Historical evidence suggests that it was actively engaged in artistic and cultural exchanges, especially with northern Indian traditions. This interaction shaped a local identity while also making the region a valuable subject for exploring broader historical influences (Pieruccini, 1997). Among these, the wooden temples of Chamba, the *Lakshana Devi* Temple in *Bharmour,* and the *Shakti Devi* Temple in *Chhatrari* (Figure 2) stand out as the only surviving examples from the 7th century, making them an invaluable part of the Cultural Heritage.

Figure 2. i) *Lakshana Devi* Temple in *Bharmour*; ii) *Shakti Devi* Temple in *Chhatrari* in the Chamba district of Himachal Pradesh *(Source: Authors)*.

Situated in the secluded valleys of the Himalayan region, these temples are the living repositories of regional history, folklore, and cultural narratives. These temples are remarkable for the complex symbolic stories told through their intricate carvings, associated fairs and festivals, annual *Jatras* (processions), and living ritualistic traditions. These ancient temples have marvelously withstood the rigors of the climate and the greater perils of human vandalism, but they bear evident traces of reconstruction and partial renovation. They were constructed of *Deodar* wood, with a stone base and slate to cover the sloping roofs, and are richly decorated with wooden reliefs and enshrined brass statues, none less than the gigantic rock-cut temples of *Ajanta* and *Ellora* belonging to the same period (Goetz, 1955). Interestingly, several motifs and structural elements found in these temples parallel those seen in *Kashmiri* stone temples, suggesting a continuity of wood-based temple traditions from Kashmir. Archaeological evidence supports possibilities, pointing to a dynamic process of cultural transmission and local adaptation that has ensured the survival of these wooden temples within the distinct context of Chamba (Handa, 2020).

Despite substantial scholarly research on their architectural and iconographic aspects (Handa, 2001; 2006; Ohri, 1991; Goetz, 1955), there remains a notable gap in presenting these narratives in an immersive, interpretive format that can aid efforts for heritage conservation and continuation. This gap is critical because the heritage value of these temples extends beyond their physical fabric to encompass dynamic cultural memory and ritual expression. This study seeks to address this deficiency by proposing an AR-VR-based framework that integrates narrative storytelling, oral histories, and ritual contexts within the digital interpretation, thereby enhancing visitor understanding and engagement. Using a duly annotated high-resolution digital model, this research conceptualizes a virtual interpretive experience aimed at evoking a sense of place, enhancing visitor engagement, and preserving cultural memory, especially highlighting non-literary narratives.

1.2 Research Methodology

This research follows a qualitative-interpretive research design, built upon a mixed-method case study approach to explore the role of digital documentation and immersive storytelling in interpreting the intricate Post-*Gupta*, *Gandhara* Style, and *Kashmiri*-style wood carvings and the *Pahari* style Murals within the ancient wooden temples of Chamba. The selected case studies—*Lakshana Devi* Temple in *Bharmour* and *Shakti Devi* Temple in *Chhatrari*—were chosen based on their cultural significance, representational relevance of early Himalayan wooden temple architecture, richness in iconographic narratives, and suitability for digital storytelling.

The methodology for this research is structured around a multi-layered framework (Figure 3) that integrates digital tools and technologies for documentation and data interpretation. At the core lies the tangible and intangible heritage associated with the case of the wooden temples of Chamba, which is the foundation of our study. These temples are digitally captured through high-precision documentation. This digital documentation serves as the basis for immersive technologies like Augmented Reality (AR) and Virtual Reality (VR). AR is employed to superimpose interpretive content—such as historical facts or architectural annotations—onto the physical environments, enhancing its contextual understanding. VR, on the other hand, facilitates fully immersive experiences of the temple, allowing users to engage with the heritage remotely.
Surrounding these technological layers is a broader interpretive ring informed by interdisciplinary theories, integrating Critical Heritage Studies (Smith, 2006) to question the traditional expert-led conservation by foregrounding community voices and

highlighting lived experiences beyond established paradigms quite radically. It also draws upon Digital Hermeneutics (Brugger, 2018), facilitating multilayered interpretation through digital media and Embodied Cognition (Varela, 1991; Johnson, 1999), which supports immersive VR as an effective medium for cultural understanding. Insights from the theories create a basis for probing digital documentation as a preservation mechanism and a narrative explication vehicle simultaneously.

The outermost layer of Digital storytelling is used to construct narrative translation of digital data into resonant and accessible experiences. Digital twins facilitate dynamic, real-time simulations of temple precincts, aiding in monitoring and conservation planning. Narrative interpretation plays a key role in linking digital reconstructions to cultural significance, while tours enhance access and participation beyond the physical site, fostering wider public outreach. Together, this comprehensive approach promotes a holistic, ethically informed, and technologically advanced interpretation of wooden temple heritage.

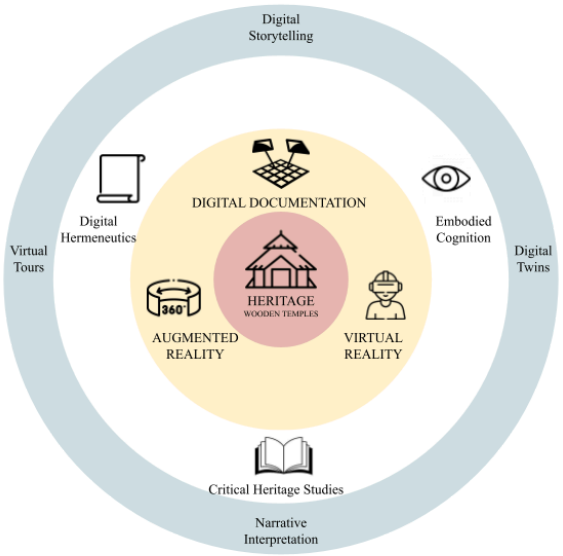

Figure 3. Theoretical framework for the study *(Source: Authors)*.

The data collection involved digital documentation with the use of a DSLR camera for sequential image capturing for overlapping to create 3D models of the temple structure and visual narratives such as wood carvings. This was further supported through visual mapping, creating architectural drawings, and conducting ethnographic interviews with members of the *Gaddi* community, temple caretakers, and priests, which facilitated the oral narratives, ritual practices, and symbolic meanings embedded in the art and architecture of the temples. Archival material from epigraphical texts and scholarly works has also been referred to provide context for the history of restoration works.

To create dense point clouds and textured mesh models, the image sets obtained were processed through Metashape. These models were refined and annotated in SketchFab for web access with just a QR code. Some interpretive layers embedded within the models allowed users to get a deeper cultural understanding. Additionally, these models were linked to AR and VR worlds generated in Unity and Unreal Engine, where immersive narration featured an Avatar in traditional Gaddi attire, festivals, simulated *Jatras*, and multilingual audio.

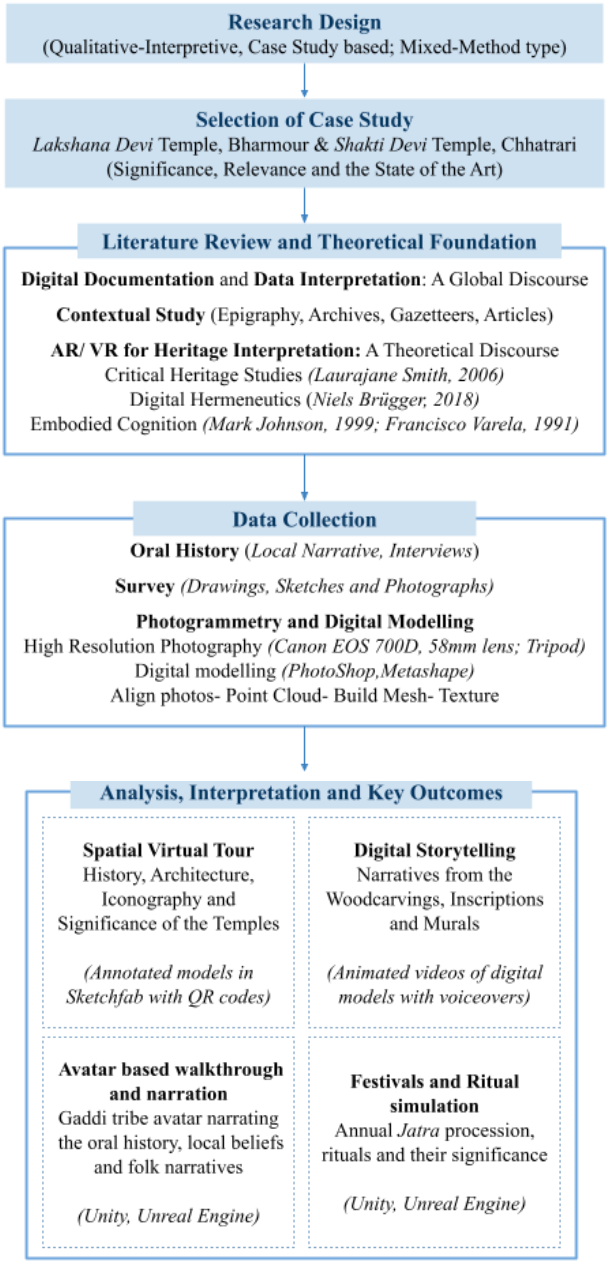

Figure 4. Research Methodology *(Source: Authors)*.

2. Literature Review

2.1 Digital Documentation and Data Interpretation: A Global Discourse

The ICOMOS Principles for Digital Documentation emphasize that digital methods should be grounded in accuracy, ethics, accessibility, and sustainability (ICOMOS, 2021). These guidelines advocate for the responsible use of digital tools to ensure heritage is interpreted and presented with cultural sensitivity and technical integrity. Recent advancements in digital documentation have expanded the scope of heritage interpretation. Photogrammetry allows for the creation of high-resolution, photo-realistic 3D models from overlapping 2D images. Studies have shown its effectiveness in archaeological documentation (Remondino & Campana, 2014) and in museum-based storytelling (Bekele et al., 2018). Scholars have emphasized how digital methods assist in both conserving

physical form and enhancing interpretation by integrating tangible and intangible dimensions of heritage. This global shift has facilitated collaborative platforms, encouraging diverse narratives and inclusive heritage practices, especially in vulnerable or remote cultural contexts.

Digital storytelling is narrative entertainment that reaches audiences via digital technology and media. Handler Miller (2008) states that digital storytelling techniques can make a dry or difficult subject more alive and engaging to the viewers. To enhance the classic storytelling concept, in which the listener remains passive, Glassner (2004) defined interactive storytelling as a two-way experience, where “the audience member affects the story itself” (Bekele, Pierdicca, Frontoni, Malinverni & Gain, 2018).

The case of *Lakshana Devi* Temple, dating to the late 7th century (post-Gupta era), preserves an intricately carved wooden entrance, interior, and ceiling with *Shiva* and *Vaishnava* motifs. At present, the temple appears as a simple hut of wood and rubble construction with a broad, far-projecting gable roof covered with slates, very similar to many local vernacular houses in the village. Inside, there is a rectangular *Mandapa* supported by four pillars interlinked by railings on both sides. Behind the *mandapa,* there opens the quadratic cella *(gabhagriha),* again with a richly carved entrance between two other pillars, enshrining the brass alloy (*Ashtadhatu*) statue resembling the iconography of *Mahishasuramardini*.

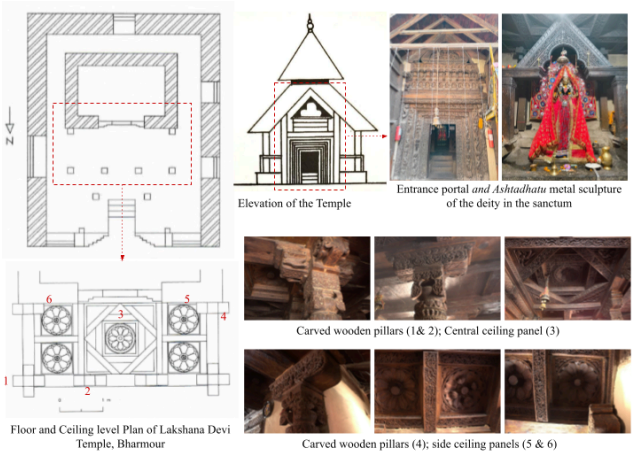

Figure 5. *Lakshana Devi* Temple, *Bharmour (Source: Authors; Reference drawings: Pieruccini, 1997 & Handa, 2020).*

Upon entry, three steps lead to a raised interior space, beginning with a pillared *mandapa*, followed by the *garbhagriha* (sanctum), both of which are enclosed within a *pradakshinapatha* (circumambulatory path). The *mandapa*, measuring approximately 4.50 × 1.94 meters, features six finely carved wooden pillars in a late *Gupta* style—four in front and two integrated into the sanctum wall—supporting a richly decorated coffered wooden ceiling adorned with lotus rosettes and medallions (Pieruccini, 1997; Handa, 2006; 2020). The sanctum, measuring 4.70 × 3.25 meters, follows a layout traditionally used for shrines dedicated to female deities. It is constructed with masonry walls, a historic wooden door, and a ceiling similar in design to the *mandapa*. Classical wooden grills are installed between the pillars on three sides, forming a kind of decorative railing.

The majestic wooden portal at the entrance of the temple comprises three main parts—the door frame, a rectangular section with three registers, and a triangular pediment. Due to its exposure, it is the most weathered part of the structure, later covered with a canopy, which gives an obstructed view, making detailed interpretation even more challenging. The enclosed space is often dimly lit, making the only surviving masterpieces of ancient wood carvings go overlooked.

Likewise, the late-7th-century *Shakti Devi* Temple in Chhatrari (Figure 6) is adorned with artistically carved pillars and entrance reliefs depicting numerous deities (*Shiva, Vishnu, Indra, Ganga, Yamuna, Navagrahas*) and colorful murals of scenes from *Dashavtara*, *Ramayana,* and *Krishna Lila.* Together, these temple complexes exemplify syncretic *Pahari* religious art and architecture. The temple structure resembles the *Lakshana Devi* temple as the original shrine, surrounded by a gallery, has external dimensions of 8.85 × 8.55 meters. Twelve wooden pillars frame the outer perimeter. Each pillar has a *Ruchika* square shaft of 45.00 × 45.00 cm, with a 1.65-meter-wide passage between the pillars and the mural walls.

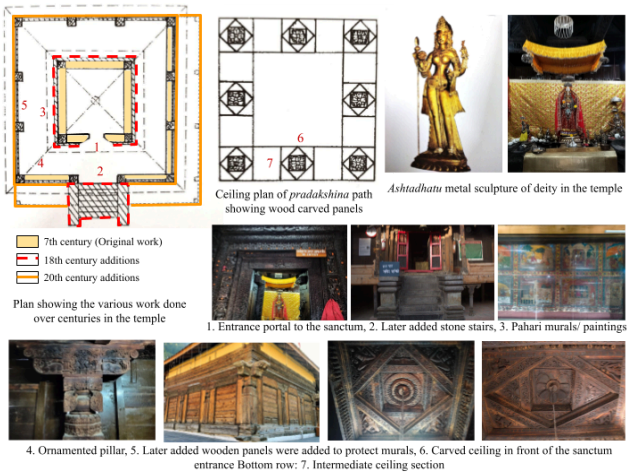

Figure 6. *Shakti Devi* temple, *Chhatrari (Source: Author; Reference drawings: Bawa, 1998).*

The plan (Figure 6) varies and even richer decorative motifs with lions in the bracket, other columns with flying *Gandharvas,* and stylized flower scrolls with the deities. The entrance to the sanctum has the outermost frieze projections to the right and left at the top corners, enclosing two sitting lions. The next frame consists of two jambs alternately decorated with three standing deities and three smaller crouching *Ganas,* each of the latter two is ox-headed, two lion-headed, one has elephant ears, and one has a face in its belly. Among the deities, *Kartikeya* with six faces and a peacock, *Indra* with his *Vajra* and the elephant *Airavata*, possibly also *Shiva*, can be recognized on the left, and the four-armed *Brahma*, with a rosary and vessel in his hand, accompanied by two *Hamsas* on the right. The lintel again is decorated with flying *Gandharvas*, those in the center holding a crown, the rest various unidentified objects, each carrying his mate on his back (Singh, 1995; Handa, 2006; 2020).

The *Shakti Devi* Temple is also known for its annual *Jatra*, held in September, which is a deeply significant ritual that intertwines religious devotion, local mythology, and performative traditions. The festival (Figure 7) begins with the ceremonial bathing ritual of the idol of Shakti Devi with the holy water brought from the *Manimahesh* Lake situated 35 km towards Bharmour and considered to be the abode of Lord *Shiva*. The villagers trek to the high-altitude lake and return with the sacred water to purify the deity once a year during the festival. The idol of the goddess is bathed and then carried through the village with the sounds of drums, conches, and other traditional instruments.

Figure 7: i) *Manimahesh* Lake; ii) Procession of the palanquin carrying the idol of the Goddess; iii) Locals wearing wooden masks to enact demonic entities; iv) Locals performing their traditional Gaddi dance in the Temple premises *(Source: Yati, Youtube)*.

One of the interesting rituals during the *Jatra* is the procession, which is an embodied performance of local folklore, where some of the locals wear wooden demonic masks representing malevolent spirits. These masked individuals enact dramatic performances and are believed to symbolically drive out evil forces from the village. As part of this tradition, they lead the procession beyond the village boundaries, acting as ritual protectors who purge the space of negativity before the goddess's blessings are invoked. The *Jatra* thus functions on multiple levels—as a ritual renewal of the village's spiritual energy, and a celebration of cultural identity through music, dance, and community participation. It reinforces the living connection between the tangible and the intangible cultural heritage.

2.2 AR and VR for Heritage Interpretation: A Theoretical Foundation

Documentation and protection of tangible and intangible heritage values involve multidimensional and complex processes. It includes both the unique characteristics and experiences of human beings and society. Documentation is often viewed as a spatial tool that freezes and records images or codes, much like a recorder or a camera. However, in contrast, people change, as do the societies or urban spaces in which they live, and their experiences and memories also evolve. Even if there is no change in physical space, every process of remembering meaning, memories, and narratives is a process of reconstruction. At this point, in the integrated documentation and conservation of tangible and intangible heritage, there is a need for tools that can evaluate both physical data and intangibles together, and update data as changes occur (Ulusoy, 2023).

Heritage interpretation through AR-VR can be enriched by incorporating storytelling that conveys intangible cultural values. Immersive narratives, when embedded within architectural simulations, help convey the layers of memory, myth, and symbolism that define heritage spaces (Kalay et al., 2008). Emotional bonds between people and places shape identity and continuity (Low & Altman, 1992), and memory is often anchored in spatial and symbolic cues (Nora, 1989). These frameworks validate the use of spatial storytelling, through visual and oral narratives, to recreate the sacred dimensions of temple spaces. We anchor our approach in a multi-theoretical framework that bridges digital documentation, immersive interpretation, and critical heritage understanding (Table 1).

Sr No.	*Theoretical Framework*	*Design Role*	*Implication*
a)	Critical Heritage Studies	Inclusion of multiple narratives (local legends, multilingual text)	Empowers diverse voices; fosters engagement with heritage; and promotes inclusive interpretation
b)	Embodied Cognition	Avatar design & fair and festival simulation	Enhances presence, memory, and emotional connection; "user is embodied in the environment"
c)	Digital Hermeneutics	Interactive annotations, storytelling layers	Enables user-driven exploration of meaning; contextualizes artifacts within a richer cultural narrative

Table 1. Theories and their implications *(Source: Diverse literature, inventoried by Authors)*.

2.2.a. Critical Heritage Studies (CHS)

This study recognizes that heritage is not merely about preserving physical structures but also involves dynamic, pluralistic, and community-based interpretations (Smith, 2006). The carvings and paintings in the Lakshana Devi and Shakti Devi temples represent embedded narratives that go beyond their material presence. Through VR, these non-literary narratives and discourses can be experienced, interpreted, and re-interpreted by diverse audiences.

2.2.b. Digital Hermeneutics

The photogrammetric models serve as digital "texts," and VR becomes a hermeneutic tool for reading and interpreting them (Capurro, 2006). Layering oral histories, iconographic cues, visual narratives, and interactive storytelling into the VR space positions the user not as a passive viewer but as an interpretive agent.

2.2.c. Embodied Cognition

The immersive nature of VR supports embodied interaction, enhancing the understanding of spatial, symbolic, and sensory dimensions of temple architecture. Users walk ritual paths, hear ambient chants, and "touch" carvings with gaze or gesture, resulting in an embodied comprehension of the sacred environment (Lakoff & Johnson, 1999).

3. Digital Documentation and Interpretation

3.1 Field Documentation and Digital Modelling

In the context of the Lakshana Devi and Shakti Devi temples, situated in remote Himalayan terrain and continually exposed to seismic forces and heavy snowfall, digital documentation emerges as a crucial tool for both heritage interpretation and conservation. These temples, with their richly carved wooden interiors, are often dimly lit, making it difficult for visitors and even researchers to discern the intricate iconography and stylistic nuances that reflect centuries of artistic evolution.

Sr no.	*Tools/ Platforms*	*Functions*	*Output*
a)	DSLR Camera	High-resolution image capture for photogrammetry	Raw photographs
b)	Metashape	Structure-from-motion; 3D model generation	Dense point cloud & textured 3D mesh (e.g. OBJ/FBX)
c)	Photoshop	Image preprocessing (color, stitching)	Enhanced textures, panoramas
d)	SketchFab	Web hosting, annotation of 3D models	Interactive annotated 3D scenes
e)	Unity/ Unreal	VR environment development, avatars	Standalone VR app, interactive world

Table 2. Tools/ Platforms used, Functions incorporated, and the Output *(Source: Authors)*.

Traditional photography and on-site observations offer limited scope in capturing details, particularly when carvings lie obscured under protective canopies. Through high-resolution photogrammetry and annotated 3D models, the study creates interactive digital twins of the temples that allow users to navigate, zoom, and examine features otherwise inaccessible or overlooked.

Figure 8. i) Images taken for photo merge; ii) Photo merged file created with 67 images; iii) Digital camera and tripod for high-resolution photography; iv) Sequential photography with overlaps; v) Point cloud generation after aligning images *(Source: Authors)*.

For the large-scale murals, which are covered with glass panels (mostly obstructed view for high-resolution photographs) within the Shakti Devi temple, multiple sequential images (Figure 8 i.) were taken with significant overlap and further photos merged in Adobe Photoshop.

For this study, the authors have used a Canon EOS 700D (Figure 8 iii.) digital camera with a 58 mm diameter lens and a tripod to click sequential images with significant overlap. These images were further processed and aligned in the photogrammetry modeling software to generate point clouds. The dense point cloud is further used to build a model, followed by the addition of texture, and a digital model is created and observed. The final stage is to create an annotated model in SketchFab for further interpretation and animated videos for visualization. These models (Figure 9) not only assist in decoding spatial, cultural, and symbolic narratives, both oral and visual, embedded in the temple architecture but also function as long-term digital archives. In case of future structural damage or material loss, such models can support accurate conservation efforts while allowing scholars, conservators, and the broader public to interact actively with these living heritage sites beyond physical boundaries. The final 3D models (mesh + texture) are exported in common formats (such as OBJ or FBX). These file formats are imported into VR development engines (e.g., Unity or Unreal Engine). In our case, the textured models of Lakshana Devi and Shakti Devi temples became the digital environments through which users can navigate in VR.

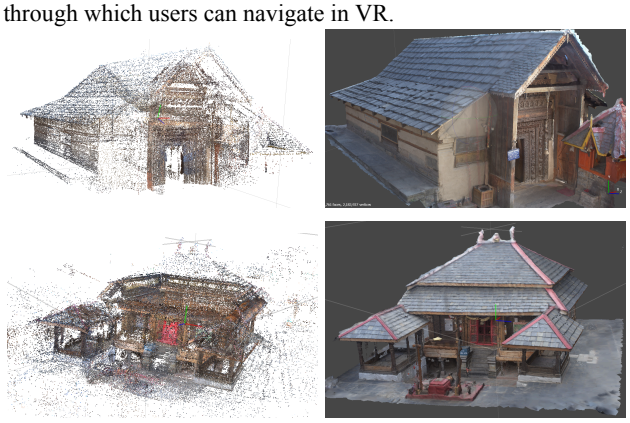

Figure 9. Point cloud and digital textured model created with Photogrammetry for i) *Lakshana Devi* temple; ii) *Shakti Devi* temple *(Source: Authors)*.

3.2 VR Simulation Framework: Integrating tangible and intangible heritage

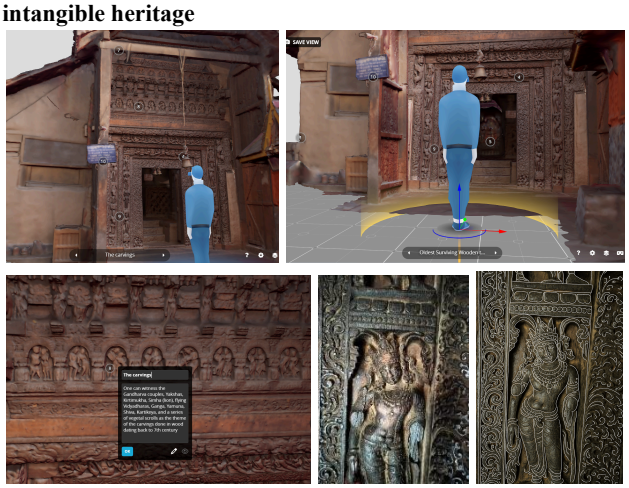

Figure 10. i) and ii) VR simulation in the annotated 3D model of Lakshana Devi temple done in Sketchfab; iii) Annotations in the 3D model make learn about the historical and cultural significance of the temple; iv) and v) Real-time carving scan to reveal the hidden meanings of the figures and the elements in the carvings *(Source: Authors)*.

Equally, intangible aspects can be represented. Virtual reality is uniquely suited to convey cultural practices: scholars note that VR “can use computer graphics to display intangible cultural heritage (ICH) to audiences, through 3D visualization,” including virtual avatars (Figure 11) that enact rituals. In our framework, the VR environment could include 360° video or animated reconstructions of a traditional shrine procession,

Pilgrim chants recorded on-site, or spoken accounts from village elders about temple legends. For instance, an avatar of a Gaddi tribe girl could narrate the story of how the Shakti Devi idol protects travelers to *Manimahesh* Lake. Ambient sound – the ringing of temple bells, folk melodies, and recitation of mantras – would further convey the atmosphere. Importantly, design literature emphasizes *interactive storytelling*: the VR experience would not be a passive slideshow but an *explorable narrative flow*. The user might, for example, “unlock” different story branches by touching carvings or following a visual cue (“story navigation module”) to the next scene.

Figure 11. i) Character Design for the Avatar from the local Gaddi Tribe *(Source: Authors, Nisha Mandavi)* iii) Festivals to be simulated in the walkthrough; iv) Proposed interface design.

4. Results and Discussion

The data-driven, immersive approach to the project produces a number of significant results. First is the **enhanced interpretation and user engagement**; by combining digital documentation and storytelling, the audience can get a holistic understanding of the history, significance, and heritage values associated with the temple structures. It also demonstrates that digital tools are essential instruments for revealing the multi-layered narratives, of both oral and visual nature, embedded in these temples, particularly those obscured by remote geographies, dim interiors, and limited scholarly access. The annotated models link visual specifics to mythology and history, echoing critical heritage principles of multiple narratives, especially non-literary narratives, such as paintings and carvings, to let the heritage structures speak their stories. The integrated immersive experience with AR-VR, based on the theory of embodied cognition, is anticipated to improve emotional and cognitive engagement with the place. The study reveals that high-fidelity VR models plus storytelling energize presence and learning profoundly.

Secondly, the **potential for heritage conservation**–the precise digital models not only capture the present state of the fragile structure and ornamented elements, but they also enable future restorations to be supported through this digital repository. Moreover, the freely available annotated 3D models provide a communicative and engaging platform for local and global heritage practitioners. Such extended and shared resources can be used by anyone to carry out research and educational activities. Furthermore, these interpretative technologies are protecting heritage by “producing engaging digital twins, guaranteeing access and continuity.”

Overall, the project is **inclusive and reflective**. Under the principles of critical heritage studies, the interpretive part of the project was developed with consultation from local custodians of the temples (priests, villagers) to incorporate local and regional interpretations. The virtual tour of annotated models gives the viewer the liberty to navigate freely within the structure. The multi-lingual guided tours and storytelling approach through Avatars in local attire provide a culturally immersive experience. The results, hence, can be used as a resource for educators, heritage managers, and tourists alike.

5. Conclusion

The research provides an outlook to interpret the heritage sites as living repositories of ancient wealth of knowledge and understanding about the Culture and Architecture. Heritage sites situated in remote valley regions often face challenges in accessibility, resulting in limited on-site interpretation of their rich tangible heritage—such as architecture and non-literary narratives, like paintings and intricate carvings—as well as their intangible cultural dimensions, including local legends and traditional festivals. Thus, the interpretation of heritage can go two ways—connecting on-site visitors as well as off-site users who are interacting with virtual environments. Using photogrammetric 3D models and story-driven interfaces, one can not only reveal the innermost architectural details of a place but also explain its cultural significance in the form of various access modes that are rich in context and experience. Augmented Reality and Virtual Reality create multisensory, enveloping environments that foster “simulated presence” and strong emotional engagement with cultural content.

Annotated 3D models serve as repositories for conservation and serve as critical mediums for engaging with intricate iconography, undocumented interventions, and temporal transformations. The workflow (Digital models + AR-VR + narrative interpretation) is a generic one that can be applied to other cultural heritage studies. Annotated 3D models serve as repositories for conservation and critical mediums for engaging with intricate iconography, undocumented interventions, and temporal transformations. This can further help research on digital technologies applied to heritage conservation. The incorporation of immersive technologies enhances participation in heritage sites and can become even more engaging.

In conclusion, this case study illustrates how data-driven tools can alter how Himalayan heritage is conserved and are turning into rich sources of information for interpretation. The project methodology and results serve as a blueprint for heritage professionals who want to inculcate intangible connections into tangible ones so that narratives embedded within the heritage structures are now preserved in cultural memory and global awareness.

References

Bekele, M. K., Pierdicca, R., Frontoni, E., Malinverni, E. S., & Gain, J. (2018). A survey of augmented, virtual, and mixed reality for cultural heritage. *Journal on Computing and Cultural Heritage, 11*(2), 1–36. https://doi.org/10.1145/3145534

Bekele, M. K., Pierdicca, R., Frontoni, E., Malinverni, E. S., & Gain, J. (2018). A review of virtual reality for the preservation and promotion of cultural heritage. *Digital Applications in Archaeology and Cultural Heritage*, 209–210. https://doi.org/10.1016/j.daach.2018.08.001

Bentkowska-Kafel, A., & MacDonald, L. (Eds.). (2017). *Digital techniques for documenting and preserving cultural heritage*. Arc Humanities Press.

Bianconi, F., Filippucci, M., Cornacchini, F., Meschini, M., & Mommi, C. (2023). *Cultural heritage and virtual reality: Application for visualization of historical 3D reproduction*. In The International Archives of the Photogrammetry, Remote Sensing and Spatial Information Sciences, Florence, Italy. https://doi.org/10.5194/isprs-archives-XLVIII-M-2-2023-203-2023

Capurro, R. (2006). Towards an ontological foundation of information ethics. *Ethics and Information Technology, 8*(3), 175–186. https://doi.org/10.1007/s10676-006-9108-0

Drucker, J. (2011). Humanities approach to graphical display. *Digital Humanities Quarterly, 5*(1).

Goetz, H. (1955). *The early wooden temples of Chamba*. E. J. Brill.

Handa, O. C. (2001). *Temple architecture of the Western Himalaya: Wooden temples*. Indus Publishing.

Handa, O. C. (2005). *Gaddi land in Chamba: Its history, art and culture*. Indus Publishing Company.

Handa, O. C. (2006). *Woodcarving in the Himalayan region*. Indus Publishing Company.

Handa, O. C. (2020). *The ancient wooden temples of Chamba, Himachal Pradesh*. Indus Publishing Company.

Hein, G. E. (1998). *Learning in the museum*. Routledge.

ICOMOS. (2002). *The ICOMOS International Cultural Tourism Charter*. ICOMOS International Scientific Committee on Cultural Tourism.

ICOMOS. (2008). *The ICOMOS charter for the interpretation and presentation of cultural heritage sites*. ICOMOS International Scientific Committee on Interpretation and Presentation.

Ioannides, M., & Patias, P. (Eds.). (2023). The complexity and quality in 3D digitisation of the past: Challenges and risks. In *3D research challenges in cultural heritage III*. Springer. https://doi.org/10.1007/978-3-031-34183-5_2

Kalay, Y. E., Kvan, T., & Affleck, J. (2008). *New heritage: New media and cultural heritage*. Routledge.

Lakoff, G., & Johnson, M. (1999). *Philosophy in the flesh: The embodied mind and its challenge to Western thought*. Basic Books.

Low, S. M., & Altman, I. (1992). *Place attachment*. Springer.

Nora, P. (1989). Between memory and history: Les lieux de mémoire. *Representations, 26*, 7–24. https://doi.org/10.2307/2928520

Martínez Yáñez, C. (2022). The ICOMOS Draft International Charter for Cultural Heritage Tourism (2021): Reinforcing Cultural Heritage Protection and Community Resilience Through Responsible and Sustainable Tourism Management. vol 482. Springer, Cham. https://doi.org/10.1007/978-3-031-06825-6_226

Ohri, V. C. (1991). *Art and architecture of the Western Himalaya*. Books & Books.

Pieruccini, C. (1997). The temple of Lakṣaṇā Devī at Bharmaur (Chambā): A new approach. *East and West, 47*(1/2), 97–121.

Remondino, F., & Campana, S. (2014). *3D recording and modelling in archaeology and cultural heritage*. BAR International Series.

Sabarirajan, A., Reddi, L. T., Rangineni, S., Regin, R., Rajest, S. S., & Paramasivan, P. (2024). Leveraging MIS technologies for preserving India's cultural heritage on digitization, accessibility, and sustainability. In *Data-driven intelligent business sustainability*. IGI Global. https://doi.org/10.4018/978-1-6684-7572-3.ch007

Singh, M. G. (1995). *Art and architecture of Himachal Pradesh*. Light & Life Publishers.

Smith, L. (2006). *Uses of heritage*. Routledge.

Sylaiou, S., Liarokapis, F., Kotsakis, K., & Patias, P. (2009). Virtual museums, a survey and some issues for consideration. *Journal of Cultural Heritage, 10*(4), 520–528. https://doi.org/10.1016/j.culher.2009.03.003

UNESCO. (1972). *Convention concerning the protection of the world's cultural and natural heritage*. UNESCO World Heritage Centre.

Ulusoy, F. O. G. (2023). *Integrated documentation of tangible and intangible cultural heritage in urban historical sites*. The International Archives of the Photogrammetry, Remote Sensing and Spatial Information Sciences. Florence, Italy https://doi.org/10.5194/isprs-archives-XLVIII-M-2-2023-701-2023