Dissemination the Value of Cultural Heritage through the Production of Media Art Based on 3D Record Data – An Example of the Media Art Exhibition Project of "Mieumwanbo, Walking through the Traditional Garden of Korea"

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Abstract

This study proposes a new approach to cultural engagement and data utilization by producing media art based on unprocessed 3D scan data of cultural heritage. Using raw point cloud data of traditional Korean gardens—acquired and archived by the National Heritage Administration—the project reconstructs immersive media content without converting the data into 3D models. This method aims to simultaneously convey both the archival authenticity and aesthetic value of the original dataset.
By integrating projection mapping, spatial composition, and sound design, the exhibition offers a multisensory experience. Technical challenges, such as large-scale data optimization, color correction, and the implementation of point cloud-based effects, were addressed using software tools including Cyclone, Blender, Unreal Engine, and After Effects. Notably, narrative elements such as fog and falling petals were also expressed in point cloud form, setting this project apart from conventional model-driven approaches.
Interviews with exhibition visitors confirmed that the project effectively increased public interest and awareness regarding cultural heritage. This case suggests a creative reinterpretation of digital heritage archives and presents a new model for preservation and dissemination through immersive digital media.

1. Research Background

The National Heritage Administration of Korea has been actively utilizing 3D scanning technologies as a core strategy for the documentation and digital preservation of the country’s cultural heritage assets. As part of this initiative, an extensive archive of three-dimensional datasets has been constructed and made publicly accessible. However, despite these efforts, the practical usage of such data by the general public remains relatively limited. The primary reasons for this include the large file sizes of 3D data, the lack of user-friendly visualization tools, and the absence of accessible platforms that can facilitate intuitive engagement with these complex digital assets.

Among the various types of 3D data, point cloud datasets are especially underutilized in both public and research domains, particularly when compared to mesh-based 3D models. While polygonal meshes are often processed for interactive simulations or virtual reconstructions, point clouds—despite their high fidelity and spatial precision—are frequently perceived as technically cumbersome and visually abstract. Moreover, much of the existing research and content production in the digital heritage field has focused on reconstructive visualization, emphasizing geometric surface modeling and photorealistic rendering, which further limits creative explorations of unprocessed data formats.

To address these gaps, the present project proposed an alternative methodology: bypassing the conventional modeling and mesh-generation processes and instead directly engaging with raw point cloud data as both a visual medium and a conceptual foundation for artistic creation. By doing so, the production team aimed to explore the aesthetic and expressive potential of point cloud datasets not merely as technical archives but as artistic material capable of evoking cultural meaning and emotional resonance. This approach positions point cloud data not only as a tool for documentation but also as a catalyst for creative interpretation and public engagement.

The focus of the project centered on traditional Korean gardens, selected for their symbolic relationship with nature, philosophical depth, and spatial harmony. These gardens—meticulously designed to reflect Confucian and Taoist ideals of balance and retreat—were reinterpreted through digital storytelling, projection mapping, and spatial media techniques. Utilizing high-resolution point cloud data of sites such as Changdeokgung’s Huwon and various secluded gardens like Bogildo’s Seoyeongjeong Pavilion, the team constructed immersive media artworks that highlight the original geometry and textures of these cultural landscapes.

Through a process that combined narrative video design, real-time effects, and multi-sensory exhibition techniques, the project culminated in a media art exhibition aimed at both aesthetic experience and educational impact. By integrating unprocessed scan data with narrative structure and sensory design, the exhibition sought to engage audiences on multiple levels—visual, spatial, emotional, and intellectual—ultimately encouraging deeper appreciation of both the tangible and intangible values embedded within Korea’s cultural heritage.

Commissioned in May 2024, production for the project began in June and the inaugural exhibition was launched in December of the same year at a major public venue. The project not only demonstrated the feasibility of using point cloud data in a non-conventional, artistic context but also opened up new directions for digital cultural content creation—suggesting that raw heritage data can be reimagined beyond preservation, as an active medium for public storytelling and aesthetic innovation.

The gardens featured in this exhibition were all selected from sites where high-precision point cloud data had been systematically acquired through the National Heritage

Administration’s 3D spatial scanning initiative. These locations reflect the aesthetic and philosophical essence of Korean traditional gardens, encompassing both royal palace gardens and private villa (byeolseo) gardens. The list of featured gardens is as follows:

- Changdeokgung Palace Huwon (2016–2017; approx. 3.01 billion points): The rear garden of Changdeokgung, the principal royal residence of the Joseon Dynasty, is renowned for its naturalistic landscaping, which respects and integrates the site's original topography. In this project, its expansive spatial depth and organic beauty were interpreted through point cloud visualization techniques.

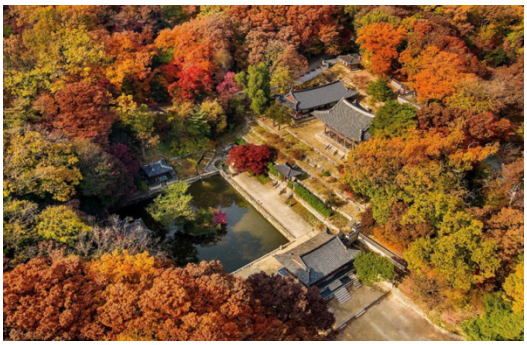

Figure 1. Changdeokgung Palace Huwon.

- Seoyeongjeong Pavilion, Bogildo Garden of Yun Seondo (2021; approx. 1.7 billion points): This site was the private retreat of Yun Seondo, a prominent poet and scholar of the late Joseon period, known for his deep appreciation of nature. The media content captured both the lyrical spirit of Yun’s poetry and the tranquil atmosphere of the garden’s harmonious composition of water, rocks, and pavilion.

Figure 2. Seoyeongjeong Pavilion, Bogildo Garden of Yun Seondo.

- Soswaewon Garden, Damyang (2021; approx. 760 million points): Built as a secluded haven for scholars, this garden embodies Neo-Confucian ideals of living in harmony with nature. Its spatial layout—featuring bamboo groves and small pavilions—offered an ideal setting for the audiovisual elements of the media artwork.

Figure 3. Soswaewon Garden, Damyang.

- Myeongokheon Garden, Damyang (2021; approx. 3.5 billion points): As its name implies—“the garden of clear jade”—this site exemplifies the refined culture of the Joseon literati. The dense point cloud data captured intricate architectural details and the elegant spatial rhythm of the garden, which were faithfully preserved in the visual rendering.

Figure 4. Myeongokheon Garden, Damyang.

- Imdaejung Garden, Hwasun (2022; approx. 2.46 billion points): Characterized by its integration of a pavilion, flowing stream, and dense forest, this garden symbolizes a harmonious relationship between humans and nature. The surrounding terrain and water features made it particularly well-suited for immersive spatial compositions using point cloud data.

Figure 5. Imdaejung Garden, Hwasun.

Collectively, these sites represent a rich spectrum of regional and typological diversity within Korean traditional garden design. Each garden also serves as a cultural heritage site imbued with distinct historical significance and emotional landscapes. For this project, they were reorganized under two thematic categories—palace gardens and private villa gardens—and reinterpreted as immersive media art content.

2. Principles Applied

This project was conceived as a projection-mapped media art installation designed to reinterpret the spatial aesthetics of traditional Korean gardens through digital means. A core objective was to create a deeply immersive and sensorially rich experience while maintaining the authenticity and documentary value of the original 3D scanning data. To achieve this balance between historical fidelity and contemporary expression, the production adhered to several foundational principles from start to finish.

At the heart of the project was the commitment to utilizing the original point cloud data—captured through high-resolution 3D scanning—without applying any modeling, mesh conversion, or geometric alteration. This deliberate constraint was intended to preserve the raw, unprocessed visual language of the data, emphasizing its inherent texture, spatial ambiguity, and computational aesthetic. Only in specific cases—such as the addition of environmental elements like sky or water, which were absent from the original scan—were non-scanned visuals introduced, and even then, they were carefully composed so as not to compromise the integrity of the point cloud environment.

For narrative-driven visual effects such as fog, drifting petals, or light particles, a hybrid technique was adopted. These elements were initially developed through conventional 3D modeling, then converted into point cloud format to ensure visual continuity with the surrounding dataset. This approach allowed for expressive storytelling without departing from the point cloud medium.

The entire video production was constructed around second-by-second, highly detailed scenario scripts, developed through extensive site research and narrative planning. Camera paths were calculated to maximize the spatial depth and movement inherent in 3D data, while visual rhythm and emotional tone were driven by a custom soundtrack composed by a professional music director. Additional sensory design included spatial lighting and scent diffusion, implemented through close collaboration with lighting designers and a scent artist, to evoke atmosphere and thematic nuance.

To enhance realism, environmental soundscapes were also developed using field recordings from each corresponding heritage site. These ambient layers—such as birdsong, wind, and running water—were carefully mixed to reflect both seasonal changes and spatial context, grounding the digital content in tangible sensory references.

By adhering to these principles, the project sought not only to honor the cultural and spatial specificity of traditional Korean gardens, but also to demonstrate the potential of point cloud data as a creative and expressive medium in its own right—capable of conveying meaning, memory, and atmosphere without the need for abstraction or conversion.

3. Implementation Methods

This project represents a novel attempt to creatively utilize 3D point cloud data within the artistic domain of media art, moving beyond its conventional use in static visualization or archival documentation. To achieve this, the production team explored a wide range of software platforms—such as Cyclone, Blender, Unity, VFX Graph, Unreal Engine, TouchDesigner, and After Effects—conducting extensive research to determine which tools would best convey the poetic sensibility and spatial depth of Korean traditional gardens. A multidisciplinary and experimental production process was designed to integrate both technical precision and aesthetic expression.

3. 1. Scenario Development and Scene Segmentation

Given the immense size of raw point cloud datasets, processing them as a whole posed significant challenges. To manage this, the team devised a time-based scenario structured down to the second. The entire narrative was segmented into individual scenes aligned with specific visual motifs and transitions. This approach not only allowed for more detailed visual storytelling but also facilitated the distributed optimization of rendering loads. The storyline was designed to simulate a slow and immersive stroll through the garden, enhancing emotional engagement through natural spatial transitions.

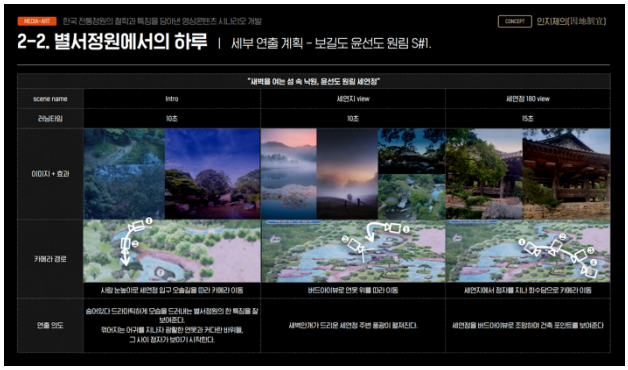

Figure 6. Scenario for Seoyeongjeong Pavilion at the Bogildo Garden of Yun Seondo.

3.2. Data Cleaning and Optimization Using Cyclone

Each scene-specific dataset was imported into Cyclone, where unnecessary or irrelevant data points were removed in the cleaning stage. Following that, optimization processes were applied to adjust the density and resolution of the data, ensuring smooth performance in subsequent rendering environments. Based on camera path designs and depth layers, the point clouds were grouped and filtered by spatial distance, allowing the rendering engine to handle them efficiently. This process helped preserve visual integrity while maintaining system stability.

3.3. File Format Conversion Using CloudCompare

The cleaned and segmented datasets were converted into compatible formats using CloudCompare. This step was essential for ensuring interoperability between different software platforms and allowed for the seamless integration of visual effects in later stages of production.

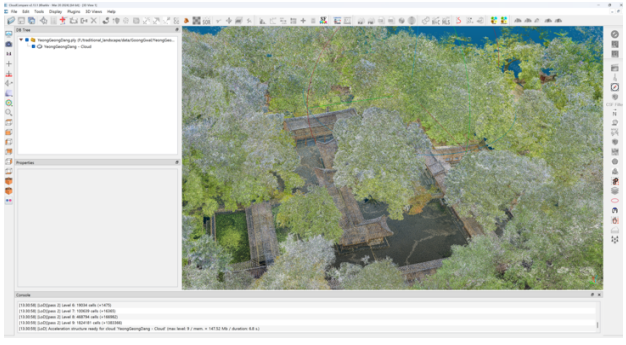

Figure 7. Data format conversion of Yeongyeongdang at Changdeokgung Palace using CloudCompare.

3.4. Seasonal Color Correction Using Blender

In Blender, the color distortions found in raw data were corrected, and point colors were adjusted to reflect seasonal aesthetics. For example, subtle greens for spring, dense foliage for summer, vibrant reds and yellows for autumn, and white snow effects for winter were meticulously implemented. Particular attention was given to simulating the texture of snow on the ground, the shimmering of water surfaces, and the tonal shifts in foliage, providing a more immersive seasonal experience for viewers.

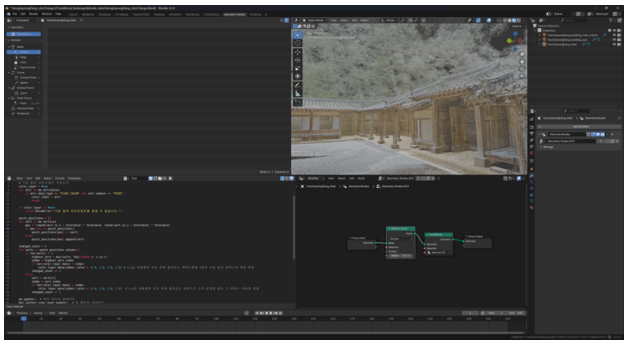

Figure 8. Point color modification of Yeongyeongdang at Changdeokgung Palace using Blender.

3.5. Scene Construction and Visual Effects in Unreal Engine

The adjusted datasets were imported into Unreal Engine for full scene construction. Lighting was carefully designed, and camera movement was choreographed to match the physical layout of the projection-mapped exhibition space. Using the Niagara Particle System, various narrative-driven visual effects were implemented—such as petals drifting in the wind or mist enveloping the landscape. Notably, these effects were also rendered in point cloud format to match the aesthetic of the original data, creating a seamless integration between archival fidelity and artistic vision.

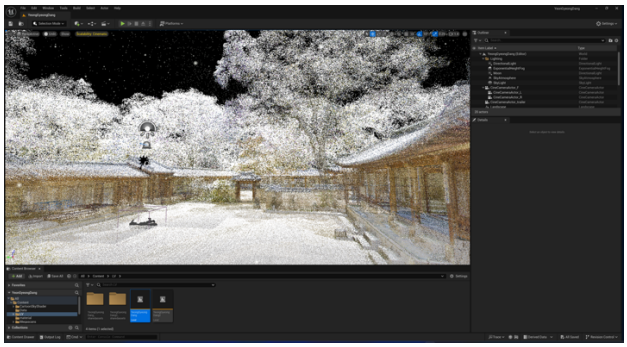

Figure 9. Effect addition and scene composition of Yeongyeongdang at Changdeokgung Palace using Unreal Engine.

3.6. Final Editing and Sound Integration in After Effects

Rendered scenes were finalized using After Effects, where background music and ambient sound were integrated. Environmental audio—such as birdsong, wind, and flowing water—was recorded directly from the original heritage sites and added to the scenes. These auditory elements enriched the viewing experience, transforming digital spaces into sensory environments that closely emulate physical presence.

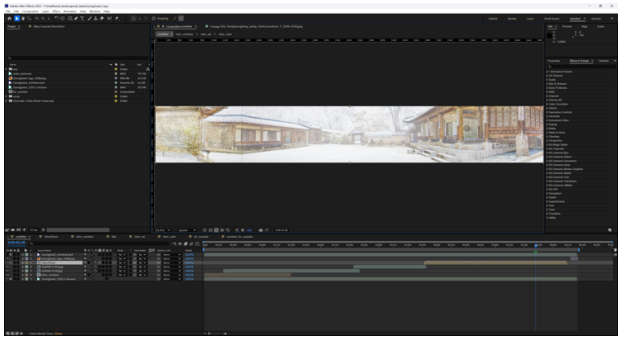

Figure 10. Scene editing and encoding of Yeongyeongdang at Changdeokgung Palace using After Effects.

This multi-software-based production workflow represents a distinctive and innovative approach to integrating point cloud data into the domain of media art. Rather than relying solely on conventional mesh modeling or standardized rendering techniques, the project creatively explored the expressive potential of raw 3D scan data by experimentally utilizing a range of specialized software tools. Through a precise understanding of each program’s processing capabilities and constraints, the team successfully achieved high-resolution seasonal representations and sophisticated color adjustments reflecting environmental variables such as foliage transitions and snowfall.

This approach can be regarded as a leading example of technical and artistic convergence in the use of point cloud data for media art. In contrast to prior visualization studies that have remained largely within the boundaries of modeling and rendering, this project preserved the physical authenticity of the original scan data while realizing artistic direction. In doing so, it demonstrated a methodology that combines technical precision with aesthetic experimentation.

To further heighten the audience’s immersive experience, the exhibition space was acoustically designed to minimize interference between different content zones, ensuring a coherent and uninterrupted sensory flow. Music was composed by Jang Young-gyu, director of the globally acclaimed band Leenalchi, who combined motifs from traditional Korean music with contemporary sound design to enrich the emotional and narrative dimensions of the work. Additionally, a professional scent designer developed customized fragrances tailored to the spatial and thematic elements of each scene. This thoughtful integration of visual, auditory, and olfactory elements resulted in a truly **synesthetic experience**, allowing viewers to engage more deeply with the reinterpretation of cultural heritage spaces.

4. Exhibition Response

The *Miumwanbo* exhibition was held across two separate occasions in 2024 and 2025, spanning a total of 71 days at two major venues in Seoul: the Ilmin Museum of Art and the Sejong Center for the Performing Arts. Over the course of these exhibitions, a total of [number] visitors experienced the media art installation firsthand. In order to assess the effectiveness of the proposed content in conveying the value of cultural heritage, in-depth interviews and surveys were conducted with a diverse group of exhibition attendees throughout the duration of the event.

The results of these interviews indicated a clear and meaningful shift in public perception regarding national heritage. Many participants reported that the creative use of unprocessed 3D point cloud data not only deepened their understanding of the historical and aesthetic significance of traditional Korean gardens, but also enhanced their emotional and spatial immersion in the exhibition. The fusion of raw digital archives with sensory design elements proved to be an effective medium for communicating complex cultural narratives to a wider audience.

In addition to the domestic exhibitions, the project garnered considerable international attention, receiving more than eight exhibition requests from institutions and organizations abroad, including in France, the United Kingdom, the United States, and Austria. This level of interest highlights the scalability and cross-cultural relevance of the media art format developed in this project, and underscores its potential as a globally deployable model for the reinterpretation and dissemination of 3D cultural heritage data through immersive digital media.

Figure 11. A scene of media content ‘King’s Sanctuary, The Palace Garden’: Exhibition venue photos “Mieumwanbo, Walking through the Traditional Garden of Korea”.

Figure 12. A scene of media content ‘Korean Literati’s Utopia, The Hermitage Garden’ : Exhibition venue photos “Mieumwanbo, Walking through the Traditional Garden of Korea”.

Figure 13. A scene of media content ‘Korean Literati’s Utopia, The Hermitage Garden’: Exhibition venue photos “Mieumwanbo, Walking through the Traditional Garden of Korea”.

Figure 14. Entrance: Exhibition venue photos “Mieumwanbo, Walking through the Traditional Garden of Korea”.

5. Conclusion

This study presents an innovative methodology that transcends the traditional role of 3D data as a mere tool for documentation and preservation. By directly employing unprocessed point cloud data of national heritage sites—without intermediate modeling—and combining it with narrative composition and aesthetic visualization techniques, the project explored new creative possibilities within the domain of media art. This approach demonstrated how digital archives can serve not only as factual records, but also as dynamic mediums for immersive storytelling, cultural interpretation, and artistic engagement. The resulting content offered audiences a multi-sensory experience that deepened their understanding of heritage while fostering emotional resonance.

Furthermore, the direct use of raw point cloud data revealed important insights into the technical limitations and structural incompleteness of existing heritage datasets. For instance, certain scans lacked essential ground textures due to the building-centric focus of the acquisition process, while others exhibited missing or distorted vegetation caused by uncontrollable environmental factors such as wind. These findings underscore the need for establishing standardized protocols for high-quality data acquisition across diverse types of heritage assets—including landscapes, architecture, and intangible environments.

As immersive and interactive technologies continue to evolve, ensuring the technical integrity and expressive potential of heritage datasets will become increasingly crucial. This study highlights the importance of rethinking heritage digitization not only as a means of conservation, but also as a creative act of reinterpretation—one that bridges archival precision with sensory imagination, and invites broader public engagement through innovative media formats.

Acknowledgements

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Appendix

 : Exhibition mobile leaflet