Technological Innovation and Architecture: Valorization of Architectural andBuilt Heritage

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Abstract: In this theoretical research, the focus is on the transmission of knowledge through the virtual representation of cultural heritage. Today, archaeological sites are no longer solely the interest of specialized archaeologists; the general public also has the opportunity to discover and explore these heritage sites through modern technics such as guided virtualtours and interactive websites.

Virtual representation is an innovative technic that plays a key role in the enhancement of cultural heritage by offering various applications. It allows for the creation of detailed digital archives, the simulation of restorations before their implementation, and the development of virtual exhibitions accessible to a global audience.

The objective of this work is to highlight the importance and advantages of virtual representation in the enhancement of cultural heritage. By exploring the various applications of this technology, including the creation of digital archives, the simulation of restorations, and the development of globally accessible virtual exhibitions, this work demonstrates how modern technologies can recreate historical sites that have disappeared or been damaged, thus offering a new perspective on the past. Furthermore, it emphasizes how these virtual representations make cultural heritage more attractive and accessible, especially for younger generations, by facilitating engagement and understanding through interactive and immersive experiences.

Keywords: Cultural heritage, virtual representation, technological innovation, valorisation.

I. Introduction:

Architectural heritage, whether built or cultural, is a key element of societies' identities, servingas a tangible link to the past. However, its conservation and promotion present significant challengesin the modern era. The preservation and transmission of this heritage face several hurdles, such as deterioration over time, limited access to certain sites, and destruction caused by conflicts or naturaldisasters.

The primary objectives of this transmission are twofold: first, to bring the history of existing remnants to life, and second, to allow the public to "have direct contact with the ruins and understandtheir significance" (Sivan, 1997). This is what archaeology refers to as "interpretation," as it seeks tounderstand the meaning of an artifact based on available clues rather than providing a simple explanation (Mahieu, 2013).

In the digital age, innovative solutions are emerging to address these issues. The evolution of technology has revolutionized how heritage is preserved and presented to the public. Virtual representation plays a central role in enhancing architectural sites, offering a way to both preserve structures and broaden their accessibility to a global audience (Stanco & Tanasi, 2011). This paper explores the impact of virtual technologies in enhancing built heritage, particularly their role in preservation, restoration, and cultural dissemination.

II. Literature Review:

- **Augmented Reality:**

In archaeology, AR presents itself as an innovative infographic solution that allows the promotion and transmission of partially or entirely lost heritage to a broad audience. This technologysuperimposes a 2D or 3D virtual model onto reality in real-time, offering the possibility of perceivingwhat no longer exists or is difficult to visualize with enhanced detail. It places the user "at the very heart of a virtual situation and scenography" (Aboulker, 2016).

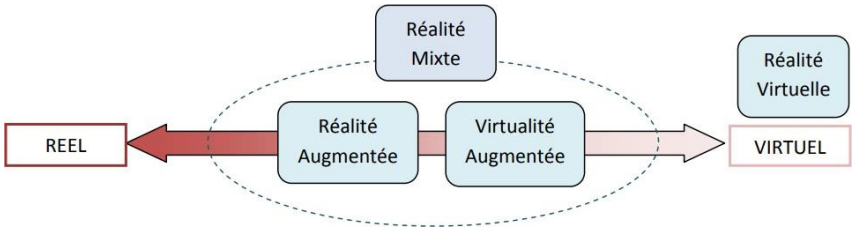

Figure 1: Paul Milgram's Virtuality Continuum (Messaoudi, 2013)

This approach allows the identification of ancient ruins often hard to spot and now integrated into modern urban and architectural landscapes. A remarkable example of the effectiveness of this method is the virtual restitution of the ancient theater of Arles, carried out by "Art Graphique et Patrimoine." This project not only allowed the study of the building's architecture but also made its remnants more visible in the modern city (Aboulker, 2016). Thanks to this innovative application, visiting archaeological sites becomes both interactive and engaging. Visitors can discover and grasp the historical reality of the site, immersing themselves in the Roman era while understanding the heritage significance of these remnants.

Figure 2: Mobile AR application for improving the experience of the tourists. (Boboc et al ,2019)

- **3D Modelling:**

3D modelling is an innovative technology that enables immersion on a real scale of a city, giving users the freedom to explore public and private monuments, as highlighted by Fleury (2010). Although this method has limitations, particularly regarding the accuracy of poorly documented historical elements (gray zones, dotted areas, etc.), it remains a powerful tool for cultural mediation and learning. A notable example is the digital model of ancient Rome created in Caen, which captivates the public and students with its ability to visually recreate the ancient city.

III. Virtual Representation: An Innovation for Architectural Heritage

Virtual representation has become an essential method for promoting architectural heritage. Thanks to modern technologies such as 3D modeling, VR, and AR, it is now possible to digitally recreate historical structures that have disappeared or are deteriorating. These innovations not only allow for the precise documentation of buildings but also their virtual restoration before any physicalintervention.

1. *Creation of Detailed Digital Archives:*

One of the most crucial applications of virtual representation is the creation of digital archives. These archives, composed of highly accurate 3D models, preserve every architectural detail and document the current state of structures. These models can be used to understand the historical evolution of the building, plan for its maintenance, and even assist in restoration after natural disasters. Thanks to drone scanning and laser scanning

techniques, the entire architecture of a buildingcan be captured with millimeter precision.

1. *Simulating Restorations Before Implementation:*

Virtual simulation offers a unique opportunity for architects and restorers to explore different restoration options without physically intervening on the building. These simulations allow the visualization of potential outcomes from different materials or restoration approaches, reducing the risk of error or damage to historic structures. Restorers can thus evaluate the impact of their choices and make informed decisions before any physical intervention.

IV. Virtual Exhibitions: Making Heritage Accessible to All

1. *Global Virtual Exhibitions:*

With virtual exhibitions, architectural heritage becomes accessible to a global audience. Whether through interactive websites or VR applications, visitors can explore historical buildings without physically traveling. This technology is particularly beneficial for hard-to-reach or endangered sites, as it allows them to be preserved while still being presented to a broad audience. The virtual recreation of the Palais des Papes in Avignon is an example, enabling thousands of visitorsto admire the beauty of the site, even remotely.

2. *Virtual Guided Tours:*

Virtual tours also provide an interactive immersion in historical buildings. Online platforms offer guided tours of World Heritage-listed sites, offering an enriching and educational experience. Visitors can explore a building at their own pace, obtain contextual information, and view architectural details that are often inaccessible during physical visits. These technologies engage the public and make heritage more attractive, especially to younger generations.

V. Impact of Technological Innovations on Built Heritage Promotion:

1. *Making Heritage More Attractive to Younger Generations:*

One of the major challenges in heritage conservation is its appeal to younger generations. New technologies, particularly virtual tours and interactive exhibitions, increase interest in historical sitesby offering an immersive and engaging experience. The interactivity and accessibility of content facilitate the understanding of cultural heritage while stimulating the interest of young people throughmodern learning methods.

2. *Preservation of Damaged or Disappeared Sites:*

Virtual technologies also allow the "revival" of buildings destroyed or damaged by conflicts, natural disasters, or simply by time. A notable example is the digital recreation of the Palmyra site in

Syria, which was severely damaged by war. Thanks to 3D models, it is possible to offer an intactvision of these places and imagine future restorations.

VI. Exemplary Projects of Promotion via Virtual Technologies:

This work adopts a theoretical approach based on case study analysis. We studied the current applications of virtual representation technologies in promoting cultural heritage, analyzing their impact on the preservation, restoration, and accessibility of various sites.

- ***Padua and Livy***

A notable example of the use of immersive technologies is the city of Padua, Italy, during the "Livius Noster: International Conference on Livy," held from November 6-10, 2017, to commemoratethe 2000th anniversary of the Roman historian's death. Among the cultural events organized, the use of augmented reality and VR headsets marked the visitors' experience. These technologies provided a unique sensory immersion, offering them the possibility to virtually explore the historical monuments and sites of Padua.

Figure 3: The augmented reality of the city of Padova. (Author, 2017)

Through augmented reality, participants could discover real-time information overlaid on the actual images of the city's iconic sites. As for VR, it revived the Roman monuments now buried beneath modern constructions. Visitors could virtually explore

three major complexes of the Roman city: the amphitheater of the Arena Gardens, the river port of the Rivera dei Ponti Romani, and the theater of Prato della Valle (Bonetto et al., 2017).

The Prato della Valle Theater, one of the most impressive monuments of ancient "Patavium," islocated at the southern edge of the city in an open area that was once used for various cultural celebrations (Bonetto et al., 2017). Part of this ancient theater was discovered during canal cleaning and exterior landscaping work (Bonetto et al., 2017). Currently, the canal is being drained inpreparation for future conservation efforts and enhancement of this historical site.

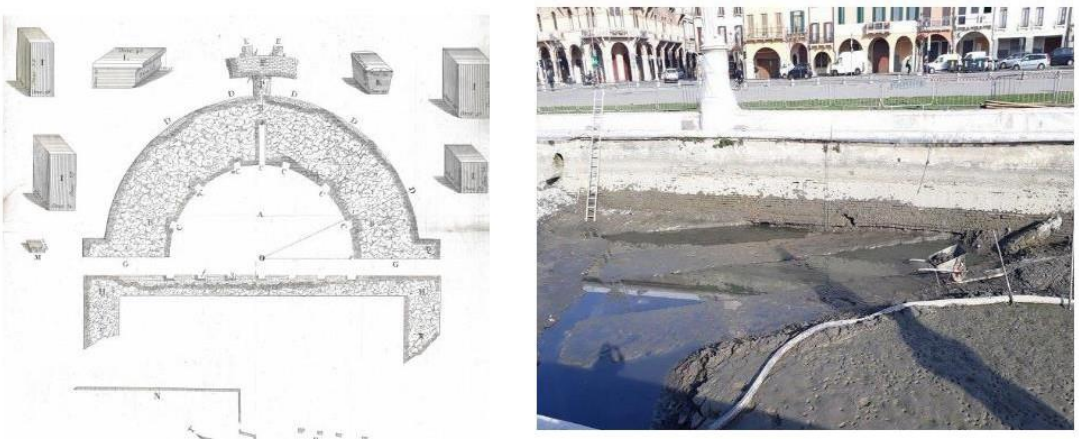

Figure 4: Roman Theatre in Prato della Vallé in Padova. (Bonetto, 2017)

VII. Conclusion:

Virtual representation and innovative technologies play a fundamental role in the promotion and preservation of architectural and built heritage. By creating digital archives, simulating restorations, and making buildings accessible through interactive exhibitions, these technologies modernize the way we perceive and preserve our architectural heritage. More than just a conservationmethod, they offer new perspectives on the past while making heritage more attractive to younger generations and more accessible to a global audience.

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