

Cultural Heritage Preservation in the Digital Age: Balancing Tradition and Innovation in Mediterranean Smart Cities

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Abstract— The preservation of cultural heritage is a crucial task in today's urban landscape, particularly in Mediterranean smart cities where historical significance is intricately woven into modernity. This article explores the complex interplay between tradition and innovation in preserving cultural heritage in the digital age. It delves into the multifaceted strategies employed to safeguard cultural treasures while embracing technological advancements in Mediterranean smart cities.

This article illuminates the evolving landscape of cultural heritage preservation by examining a diverse range of case studies and theoretical frameworks. It investigates how digital technologies, such as 3D scanning, virtual reality, and augmented reality applications, are revolutionizing traditional approaches to conservation and interpretation. Moreover, it scrutinizes the delicate balance between the imperatives of preservation and accessibility, interrogating the ethical considerations inherent in digitizing cultural artifacts and sites.

The article will highlight the pivotal role of community engagement and stakeholder collaboration in fostering a holistic approach to cultural heritage preservation. It examines how digital platforms facilitate dialogue between diverse stakeholders, empowering local communities to actively participate in the preservation process and ensuring that preservation efforts resonate with the cultural identity and aspirations of the inhabitants.

It underscores the imperative of integrating technological advancements into heritage management practices while upholding the intrinsic values and significance of cultural heritage. By embracing the synergies between tradition and innovation, Mediterranean smart cities can chart a sustainable path toward preserving their rich cultural legacies for future generations.

Keywords—cultural preservation; digital; technologies; 3D

I. INTRODUCTION

The sun-drenched shores of the Mediterranean cradle a vibrant tapestry of cultural heritage, a testament to the region's rich history and diverse communities. From the ancient ruins of Rome and Greece to the bustling souks of Marrakech and the enchanting Alhambra palace in Granada, the Mediterranean's cultural landscape speaks volumes about the enduring legacy of empires, traditions, and artistic expressions. In the face of rapid technological advancements and the rise of smart cities, we must not forget the beauty and value of our rich culture and heritage. Let us embrace the opportunities presented by digital innovation, while also taking effective measures to preserve and share our legacy with the world.

This delicate balancing act necessitates a multifaceted approach that fosters collaboration, respects tradition, and leverages the power of technology responsibly. This exploration delves into the challenges and opportunities surrounding cultural heritage preservation in the digital age, focusing on the unique context of Mediterranean smart cities.

The destruction of numerous cultural heritage sites in recent years raises questions about the efficacy of traditional preservation methods. It is pertinent to consider the longevity of these techniques over time, particularly in the face of natural disasters. In light of this, there is a growing interest in using advanced technologies to preserve the memory of buildings by means of analysis, scanning, and modeling. Such measures could potentially extend the lifespan of cultural heritage sites and traditions, as the availability of blueprints ensures that they can be reconstructed in the future.

II. THE DELICATE BALANCING ACT

In order to preserve cultural heritage in the digital era, it is important to strike a careful balance between upholding tradition and embracing innovation. Although digital technologies present promising opportunities, it is crucial to use them in a manner that fully respects the cultural values and authenticity of the heritage they aim to portray.

It is essential to ensure that digital representations do not alter or belittle the true essence of cultural heritage. For instance, even though virtual reality experiences can provide a realistic view of historical sites, it is necessary to maintain historical accuracy and context within these experiences. Moreover, digital disparities can worsen current inequalities, which might lead to certain communities being excluded from participating in digital heritage initiatives. It is of utmost importance to address accessibility needs and guarantee inclusivity by offering diverse formats and user-friendly interfaces.

Various traditional techniques have been used by Mediterranean cities to protect their cultural heritage for hundreds of years. These cities have been responsible for safeguarding their past, from carefully restoring ancient monuments to preserving invaluable artifacts. However, urbanization, environmental degradation, natural disasters and human impact have necessitated novel approaches to heritage preservation.

We must come to terms with the Digitization¹ before we can rebuild for a smarter and more sustainable environment. This action will present ethical challenges regarding the authenticity of the information gathered from scanned buildings and the original stories behind the culture. Despite this, The World Intellectual Property Organization (WIPO) has encouraged indigenous communities to digitize their intangible heritage, such as songs, dance, and rituals, since these assets are not protected by traditional intellectual property systems². This further unbalance the relationship between reality and digital information, as the process will be subject to significant ethical regulations and funding challenges. Digitization initiatives typically require external funding and donor support due to the high costs involved³.

2.1. Ethical challenges and solutions :

3D scanning technology has brought a revolution in cultural preservation and heritage documentation. However, there are ethical considerations that cannot be overlooked. One of the most significant issues is the loss of

"aura" of authenticity that 3D replicas cannot capture. This means that the sensory experience and historical context of a monument might not be fully represented.

Another concern is commercialization and inaccessibility, where 3D data could be monetized, rendering it inaccessible to those without access to technology. Moreover, ownership of digital replicas is also a matter of concern, with source countries and indigenous communities having little control over how their cultural heritage is represented. The risk of misrepresentation and reconstruction, leading to a false historical record, is also a significant ethical problem.

Lastly, 3D scans can capture sensitive data, raising privacy concerns for individuals depicted in historical sites, and data security breaches could also be a risk.

Of course when it comes to 3D scanning and preservation of cultural heritage, there are several ethical concerns that must be addressed a need for transparency and collaboration between all relevant stakeholders is crucial, along with obtaining consent and participation from cultural institutions, communities, society and 3D scanning teams.

Projects must prioritize open access and equity, ensuring that 3D data is made available whenever possible, promoting inclusivity and educational use. The focus should be on respecting cultural heritage, not solely on commercialization.

To ensure data quality, accuracy, and ethical considerations, establishing international guidelines for 3D scanning projects is necessary. Additionally, robust data security measures are needed to protect sensitive information captured during scanning.

Utilizing 3D technology can be a great tool to educate the public about their cultural heritage and encourage community involvement in its preservation. It is important to ensure that both parties are respected during the collection of this cultural information. The use of digital scanning devices should be encouraged and promoted as a means of empowering individuals. By doing this, we can create a basis for future generations to always refer to when needed, and ensure that these benefits are marketed effectively.

III. THE POWER OF DIGITAL TECHNOLOGIES

We are fortunate to live in the digital age, as it provides us with a plethora of solutions for preserving cultural heritage. Innovative technologies such as 3D scanning, virtual reality (VR), augmented reality (AR), and digital archives enable us to document, record, and present cultural heritage like never before. These technologies allow us to discover new ways of showcasing and preserving our cultural heritage.

Utilizing 3D scanning technology, it is possible to create detailed digital replicas of historical sites. This innovative approach enables people to access these cultural treasures regardless of their location or physical limitations. For example, the CyArk initiative leverages 3D scanning

¹* United Nations Educational, Scientific and Cultural Organization.

"Fundamental Principles of Digitization of Documentary Heritage."

UNESCO.org. Accessed February 11, 2017.

²*World Intellectual Property Organization, "Intellectual Property and Genetic Resources, Traditional Knowledge and Traditional Cultural Expressions,"

WIPO.int, 2015, accessed August 30, 2017

³*P. Conway, "Preservation in the Age of Google: Digitization, Digital Preservation, and Dilemmas," *The Library Quarterly* 80, no. 1 (2010): 61–79.

technology to document and preserve endangered cultural heritage sites all over the world.

The CyArk initiative has scanned over 200 sites since 2003. They partnered with Google Arts & Culture to create a platform for open access to these sites⁴. However, rare are the sites recorded from the Mediterranean cities, but none of them were from Morocco. The CyArk 500 initiative has registered some 3D databases in the south-eastern Mediterranean, which aims to digitally preserve 500 sites over 5 years⁵. By using the 3D data, they can present the site as it currently exists and provide increased access to the material culture shown on the site today, maybe even allowing for a possible reconstruction, furthermore, this method offers a permanent record of these sites, facilitating research and preservation efforts.

Using VR technology, people can experience immersive environments that take them back in time, allowing them to discover forgotten civilizations and ancient landmarks. The British Museum has implemented VR technology for its "Egyptian Experience" exhibit, which offers a virtual glimpse into historical tombs and temples, providing visitors with a comprehensive understanding of the rich cultural heritage of Egypt.

Augmented Reality (AR) technology on the other hand is transforming the way we experience physical locations by overlaying digital information into the real world. One such example is the "Valletta AR" app. This application is designed to enhance the experience of visitors to Valletta, the capital of Malta, by providing them with a unique and immersive way to explore the city's rich history.

With the "Valletta AR" application, visitors can use their smartphones to point at specific landmarks and uncover hidden layers of information about the city's history. It provides a wide range of information, including details about the architecture, historical figures, and long-forgotten events associated with each location.

Through the use of 3D models, animations, and audio, the application transforms the city into an interactive museum, offering visitors a deeper understanding and appreciation for Valletta's cultural heritage. Whether you are interested in exploring the city's ancient fortifications, learning about the Knights of St. John, or uncovering the secrets of the city's hidden gardens, the "Valletta AR" app is an excellent tool for discovering the rich history and culture of this beautiful city.

As an exemple let's not forget The fire at Notre Dame Cathedral in France, Paris in 2019 was a catastrophic event that captured the attention of the world. The spire's collapse in flames was a significant loss to the structure's identity, but the availability of extensive architectural plans and

historical photographs allowed for a roadmap to be established for the reconstruction process. Nevertheless, the integration of high-resolution 3D scanning technology could have played a fundamental role in preserving the intricate details of the spire beyond flat images and blueprints. A comprehensive 3D scan of the spire could have captured every detail, from the precise angles of its wooden beams to the delicate curves of its lead covering. Such a digital record would have served as an invaluable guide for the reconstruction, ensuring that not only the overall shape but also the subtle details that imbued the spire with its unique character were replicated. Consequently, the reconstruction process would have been significantly aided by examining a 3D printed replica of the original spire, allowing a tactile reminder of its lost presence. The result would have ensured that the new spire faithfully reflected the spirit of the original in all its nuanced details, preserving the identity of the Notre Dame Cathedral for future generations.



Image 1

Digital archives are becoming crucial for safeguarding intangible cultural heritage by providing a permanent storage. Europeana, a virtual library that compiles cultural heritage resources from all over Europe, allows users to access digitized materials such as documents, recordings, and artifacts associated with traditional crafts, languages, and folklore. This ensures that these materials are preserved and made available to future generations

IV. COMMUNITY ENGAGEMENT AND COLLABORATION

Active participation and collaboration from local communities is crucial for the success of any digital heritage project. These communities are the ones responsible for safeguarding their cultural heritage and have a wealth of knowledge and perspectives that need to be incorporated into the planning, development, and

⁴* Underhill, Justin. "In conversation with CyArk: digital heritage in the 21st century." *International Journal for Digital Art History* 3 (2018).

⁵* Lee, Elizabeth. "4.13 3D SCANNING AS AN ALTERNATIVE TO RECONSTRUCTION: THE CYARK 500 CHALLENGE." *PROCÈS-VERBAL/PROCEEDINGS* (2016): 144.

Image 1 : The burning cathedral Notre Dame de Paris, in April 15, 2019, Habitually Chic® » Cathédrale Notre-Dame de Paris

execution of digital solutions. It's imperative to integrate their insights for digital heritage initiatives to be effective.

Engaging with communities helps to create a sense of ownership and gives them the power to influence how their cultural heritage is presented and preserved in the digital world. By doing so, it guarantees that traditional knowledge and skills are not lost, but instead get integrated into innovative technologies, thus enabling a more comprehensive and nuanced representation of cultural heritage.

Collaboration between cultural institutions, technology experts, urban planners, and local communities is crucial to ensure that digital heritage projects are sustainable and inclusive. By combining their resources and expertise, these diverse stakeholders can develop solutions that are customized to the specific needs and perspectives of local communities, promoting a more equitable and sustainable future for cultural heritage in the region. Insights on a culture can be gained from locals who follow specific cultural lifestyles. These locals can provide information on the details of the heritage preserved, as well as history and storytelling about each location or patrimonial building encountered. This can help in getting a better understanding of the specific construction of the building, its original purpose, and any renovations made over time.

V. CASE STUDIES : LEARNING FROM THE MEDITERRANEAN

The Mediterranean region is home to a number of cities that are leading the way in terms of preserving cultural heritage in the digital age. Through their innovative approaches, these cities are providing valuable insights into the potential of technology to support heritage preservation efforts, while also emphasizing the importance of community engagement in this process. By leveraging a range of digital tools and platforms, these cities are creating new opportunities to engage people in the protection and celebration of their cultural heritage, while also fostering a sense of pride and connection among local communities.

These case studies offer a compelling example of how technology can be harnessed to create positive social impact and promote a sense of cultural continuity in an increasingly digital world.

1. The Bardo National Museum/ Tunisia :

The Bardo National Museum in Tunisia has implemented virtual reality technology to enhance the experience for visitors. Its vast collection of Roman mosaics and artifacts can now be explored through VR headsets. This allows people to delve into archaeological sites that were previously inaccessible, such as the ancient city of Carthage. By stepping back in time, visitors can witness the historical treasures firsthand.



Image 2

2. Valletta AR app/Malta :

Valletta, the capital of Malta, is a UNESCO World Heritage City famous for its rich history and Baroque architecture. It is a fortified city with stunning 16th-century architecture that poses a unique accessibility challenge. In 2018, the University of Malta and Heritage Malta launched a successful project that utilized 3D scanning technology to capture the intricate details of key landmarks. The data acquired was used to create immersive 3D virtual tours, significantly improving accessibility for all visitors.

Valletta AR, an app that demonstrates the power of AR, allows visitors to reveal layers of information about the city's past by pointing their smartphones at specific landmarks. The app breathes life into the city's streets by providing details about architectural features, historical events, and the stories of its inhabitants, fostering a deeper understanding and appreciation for Valletta's unique heritage.



Image 3



Image 4

3. The Born Cultural Centre in Barcelona/Spain :

The Born Cultural Centre in Barcelona is an example of how digital tools can connect the past and present. This centre is built over the excavated remains of a medieval

Image 2 : Image of the Museum from inside, "Bardo National Museum."

Tunisian Tourism, https://en.wikipedia.org/wiki/Tourism_in_Tunisia. Accessed March 3, 2024.

Image 3 : image of the logo of the application that can be found on the Playstore :

<https://play.google.com/store/apps/details>

id=com.BewitchedMitches.VallettaStreetsofHistory&pli=1

Image 4 : an image of the application itself that can be found here :

<https://timesofmalta.com/article/historical-valletta-mobile-videogame-launched.1016004>

neighborhood that was destroyed in the 14th century during the city's expansion. The centre seamlessly integrates digital archives, interactive exhibits, and educational programs to offer visitors a comprehensive experience. People can explore the archaeological remains, view multimedia exhibits that showcase Barcelona's historical and cultural evolution, and participate in educational workshops, all of which contribute towards a dynamic and engaging experience with the city's rich history.

The cultural center embraces the latest technological advancements to make the information more interactive and fun for visitors. They are not afraid to use what they can afford to pique the curiosity of their guests some of these technologies being :

- Visitors can use interactive touchscreens to access comprehensive information about the archaeological site and its historical context. These screens enable visitors to explore the site at their own pace and delve deeper into specific facets of the past.
- Visitors can witness the evolution of the site from a lively medieval marketplace to the current excavation site using AR technology. The visualization provided by AR technology enhances their comprehension of the space's vibrant past.
- Barcelona's past can be experienced through captivating multimedia presentations that incorporate visuals, sound effects, and historical narration. These presentations have been designed to transport visitors back in time and provide them with a multi-sensory experience.



Image 5

4. The Cala Minnola shipwreck/ Italy :

The Cala Minnola shipwreck is located in the deep waters near Levanzo Island in Italy. It is a valuable historical artifact from the Roman era. However, accessing and exploring the shipwreck is challenging due to its submerged location. That's where the VISAS project

comes into play. It employs digital technologies to uncover the secrets of underwater cultural heritage, making it accessible to a wider audience.

Studying sunken ships is a challenge due to diving being restricted to a limited group of experts. However, the VISAS project has found a solution to this issue through the use of advanced tools like 3D scanning technology. With this technology, researchers can create a replica of the shipwreck in virtual form which can be easily accessed and analyzed without requiring physical diving. Additionally, this approach helps protect the underwater environment by providing a permanent record of the wreck. Through the use of virtual and augmented reality technologies, the project offers interactive encounters, surpassing the limitations of traditional images. Cala Minnola is accessible to all, regardless of their diving background, allowing them to explore the site, study relics, and gain insights into its past, which fosters a more profound awareness and comprehension of the maritime history.

Trained divers can enjoy an even better experience with the help of an augmented diving system. This technology uses an underwater tablet to display real-time data on the diver's view, assisting them in navigating through the wreck and offering important historical background on specific aspects.

The case study of Cala Minnola illustrates how digital technologies have had a favorable impact on the preservation of underwater heritage and increased public engagement. VISAS is leading the way in making cultural heritage more accessible and encouraging responsible exploration, creating a future where scholars and the general public alike can connect with the past and gain valuable knowledge from the depths below.

Each study case gives us an idea of how advancing technology has made it possible to preserve and analyze buildings in great detail using 3D digital files. This has become more of a reality than just a digital experiment, allowing for accurate analysis, plans, blueprints, and 3 dimensional views of existing structures. By digitally preserving buildings, we can secure their architectural memory and cultural usage before making any changes to them, whether they be technological or due to natural or human-made disasters that could damage the monument. This technology can also be used to meet the needs of the Mediterranean smart city project.

We can easily name many monuments that have significant cultural heritage and history which once enriched our living environment but have unfortunately been destroyed. For instance, The Great Mosque of al-Nuri in Mosul, Iraq was destroyed in 2017, The Temple of Bel in Palmyra, Syria in 2015, The Souq Al-Attarine in Aleppo, Syria, which dates back to the 14th century, has suffered extensive damage due to the ongoing Syrian Civil War, The Palace of Nineveh in Iraq has faced repeated damage throughout history, most recently during the 2003

Iraq War and is currently under threat, and the Kilwa Kiswani Mosque Complex in Tanzania, a UNESCO World Heritage Site that comprises mosques, tombs, and other structures dating back to the 14th-16th centuries, is facing erosion, rising sea levels, and a lack of resources for conservation.

VI. CONCLUSION

Empires may come and go, but the stories of cultural heritage can keep shining a light on our collective future. By combining innovation with tradition, smart cities in the Mediterranean can create a future where technological advancements and cultural heritage can coexist.

Balancing tradition and innovation in cultural heritage preservation requires a commitment to the following:

- Community-driven approaches: Local communities should have an active role in shaping their digital heritage experiences by contributing personal stories, and historical knowledge, and even participating in crowdsourcing initiatives, enriching the digital record with diverse perspectives. Feedback through focus groups and social media engagement ensures content resonates with the community.
- Inclusivity and accessibility: Digital heritage initiatives should be designed to cater to diverse audiences, regardless of age, ability, or technical literacy.
- Respecting cultural values and authenticity: The use of digital technologies should be respectful of the cultural heritage they represent, avoiding distortion or trivialization.
- Building for the future: Cultural heritage preservation should be integrated into smart city development plans for sustainable and successful implementation.

The region of the Mediterranean, which is considered as the birthplace of civilization and an evidence of human ingenuity, provides a unique opportunity to explore the future of preserving cultural heritage in the digital era. By incorporating innovative technologies while maintaining respect for tradition and involving the community, the region can lead the way towards a future where cultural heritage thrives as an integral and enriching part of our collective human experience.

Change can be exciting, but it's important to remember our roots and where we came from. We must preserve our history and culture while looking toward the future of smart cities. It's a positive step forward, but we must approach it with care and consideration. I hope we can all

work together to create a better world that values both progress and tradition.

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Reviews :

Review 1

The research gap should be clearly identified.

In your abstract you should write the most important results.

What the impact of this result?

Make explicit the novelty of your research by comparing relevant studies that have already been conducted (Gap analysis). If necessary, provide what impact your research may have.

In the conclusion, it is necessary to emphasize the novelty, limitations, and recommendations.

The reference list is rather short. Expanding this list to compare the findings of this article with other research is advisable. It is necessary to utilize the most recent references.

The author also should provide and activate all the in the reference list where possible.

The article is not well-formatted.

Review 2

The paper "Cultural Heritage Preservation in the Digital Age: Balancing Tradition and Innovation in Mediterranean Smart Cities" explores the intersection of tradition and innovation in preserving cultural heritage. While it effectively discusses the potential of digital technologies like 3D scanning, virtual reality, and augmented reality in cultural preservation, it overlooks significant drawbacks and ethical concerns. The paper fails to address the risk of distortion or trivialization of cultural heritage in digital representations and the potential exclusion of certain communities from digital initiatives. Moreover, it lacks critical examination of the sustainability and long-term effectiveness of digital preservation methods. Despite highlighting innovative projects in Mediterranean cities, the paper's uncritical portrayal of digital solutions undermines its credibility, ultimately weakening its contribution to the discourse on cultural heritage preservation.

Review 3

1. The author should elaborate on specific examples or case studies where such collaboration has been particularly successful in Mediterranean smart cities?

2. What specific ethical challenges have you encountered during your research, and how do you propose addressing them in practice?

3. What measures do you suggest to overcome digital disparities and ensure that diverse communities can actively participate in and benefit from digital heritage projects?

4. The should discuss specific examples where these technologies have been successfully implemented in Mediterranean smart cities, and what impact they have had on preservation efforts?

5. How do you propose addressing the funding challenges associated with digital heritage projects, especially in regions with limited resources or competing priorities?