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TOWARDS A DIGITAL ARCHIVE OF MEMORY: INTEGRATED GEOMATICS DOCUMENTATION OF SITES OF INCARCERATION, VIOLENCE AND POLITICAL IMPRISONMENT. THE CASE STUDY OF THE CORFU PRISONS, GREECE

Abstract:

This paper presents an integrated geomatics workflow for the digital documentation of historic sites of incarceration and political repression, focusing on Corfu Prisons, Greece. Using modern geomatics methodologies, the study produces a high-resolution, multi-source dataset that captures the architectural, spatial, and material characteristics of the site. The resulting outputs form the basis for a broader Digital Archive of Memory, designed to support heritage preservation, historical research, and public engagement. The research demonstrates how geomatics can provide rigorous documentation for vulnerable and contested heritage sites, contributing to their long-term protection and interpretive accessibility.

Keywords: Geomatics, Digital heritage, Digital Twins, Historic prisons, Political repression, Corfu workhouse prison

КА ДИГИТАЛНОМ АРХИВУ СЈЕЋАЊА: ИНТЕГРИСАНА ГЕОМАТСКА ДОКУМЕНТАЦИЈА ЛОКАЛИТЕТА ЗАТВАРАЊА, НАСИЉА И ПОЛИТИЧКОГ ПРОГОНА. СТУДИЈА СЛУЧАЈА КРФСКИХ ЗАТВОРА, ГРЧКА

Сажетак:

Овај рад представља интегрисани геоматски радни оквир за дигиталну документацију историјских локалитета затварања и политичке репресије, са фокусом на крфске затворе у Грчкој. Примјеном савремених геоматских методологија, у студији је формиран вишеизворни скуп података високе резолуције који обухвата архитектонске, просторне и материјалне карактеристике локалитета. Добијени резултати чине основу ширег Дигиталног архива сјећања, осмишљеног у циљу подршке заштити наслеђа, историјским истраживањима и јавном представљању. Истраживање показује на који начин геоматика може обезбиједити свеобухватну документацију угрожених и спорних мјеста наслеђа, доприносећи њиховој дугорочној заштити и интерпретативној доступности.

Кључне ријечи: геоматика, дигитално наслеђе, дигитални близанци, историјски затвори, политичка репресија, крфски казнено-радни затвор

1. INTRODUCTION

The history of prisons is inseparably linked to the history of the society that builds and operates them. The way the penal system is structured and functions at any given moment reflects the political will and cultural values of that era. As the writer Fyodor Dostoevsky famously noted, “The degree of civilization in a society can be judged by entering its prisons.” [1]. The purpose of the present study is to investigate the contribution of geospatial methodologies, and more specifically the use of three-dimensional scanning, in the museum-oriented adaptive reuse of certain cells in the Corfu Prisons, with the ultimate goal of proposing the establishment of a museum within the Corfu Prisons, Greece. This is the prison where, between 1936 and 1940, the General Secretary of the Communist Party of Greece (KKE), Nikos Zachariadis, and other leading members of the KKE were held in individual cells under conditions of complete isolation; where Aris Velouchiotis was detained in 1939; and later, Nikos Belogiannis and, shortly thereafter, Charilaos Florakis. During the 7 years dictatorship in Greece, the Corfu Prison facility housed a population of inmates serving long-term criminal sentences, primarily life imprisonment, alongside political prisoners from the Military Junta regime. Beyond its primary custodial function, Corfu Prisons maintained various workshops. In 1988, the entire complex of the Corfu Prisons was officially designated as a historically protected monument under the jurisdiction of the Ephorate of Antiquities of Corfu (H.G.G. 416/ B/ 21 – 6 – 88). Despite this architectural and cultural designation, the facility has continued its uninterrupted operation as a functional correctional institution.

The tension between the building’s functional use and its historical value was highlighted in 1996, when the “Lazaretto” Association formally petitioned for the relocation of the prison and the subsequent conversion of the landmark structure into a museum. While the prison remains operational, significant shifts toward memorialization and education occurred in 2017. In March of that year, the Minister of Justice, Transparency, and Human Rights, Stavros Kontonis, abolished the use of the nine disciplinary isolation cells and announced their transformation into a site of historical memory. This move toward rehabilitation and culture was further solidified later that year; on July 26, 2017, the establishment of a Second Chance School was approved within a 130-square-meter area of the facility. The integration of academic and cultural initiatives culminated on October 29, 2017, with the simultaneous inauguration of the Second Chance School and the opening of the prison’s first exhibition, curated under the scientific supervision of the Museology Laboratory of the Ionian University.

The preservation of sites connected to political repression has increasingly become a central concern within the fields of heritage conservation, digital humanities, and memory studies. Prisons that formerly held political detainees serve as powerful sites of remembrance, embodying narratives of conflict, resistance, and state violence. When such facilities are no longer operational and are officially recognized as historic monuments, e.g. the Kilmainham Gaol (Dublin, Ireland), the Lukiškės Prison 2.0 (Vilnius, Lithuania), the Robben Island (Cape Town, South Africa), the Alcatraz Island (San Francisco, USA) and the Izzeddin Fortress (Chania, Greece), the need for precise and comprehensive documentation becomes critical for safeguarding their architectural, historical, and social significance. Digital methodologies for Cultural Heritage documentation provide new opportunities to record, interpret, and communicate these spaces in ways that extend far beyond the limitations of traditional documentation.

Among the available methodologies, Terrestrial Laser Scanning (TLS) has emerged as one of the most robust methods for capturing built heritage with high accuracy [2]. TLS generates dense point clouds representing the geometry of a site, enabling the faithful reconstruction of complex, irregular, or deteriorating structures [3]. This precision is particularly valuable for 19th-century masonry prisons—often characterized by narrow corridors, vaulted ceilings, varied cell dimensions, and irregular construction—where traditional surveying may fail to capture subtle spatial conditions. TLS has been effectively used in the documentation of historical fortifications [4], archaeological ruins [5], and industrial-era architecture [6], demonstrating its versatility and reliability in heritage contexts.

Recent research emphasizes that the digital recording of carceral heritage is not merely a technical exercise but also a means of preserving complex memory landscapes. Carceral sites frequently constitute forms of “difficult heritage” [7], where traumatic histories intersect with ongoing political and social debates. Three-dimensional models of prisons associated with political repression provide valuable tools for researchers, educators, and the public, enabling critical engagement with spaces that may be closed, unsafe, or ethically sensitive to visit in person. 3D visualization has been shown to enhance understanding of spatial practices within prisons, including surveillance, confinement, and resistance [8], [9]. As a result, digitized carceral spaces increasingly function as virtual

memorials, supporting human rights documentation, transitional justice initiatives, and community-driven memory projects.

Parallel advances in web-based 3D visualization have further transformed the dissemination of digital heritage. Platforms using WebGL, unity-based viewers, or custom online point cloud engines now allow high-resolution models to be interactively explored via standard web browsers, without specialized hardware [7], [8]. This democratizes access to heritage sites and supports public history initiatives that transcend geographic and political boundaries. Researchers have demonstrated that online 3D environments can foster engagement, deepen empathy, and enhance awareness of historical injustices by allowing users to virtually navigate spaces of confinement [9], [10].

The prison of Corfu examined in the present study. In 1840 the building was founded and the Corfu Prison began its operation in 1847. It was the first structure in the Greek territory to be built exclusively according to prison-specific architectural standards and later – 1936- used to detain political prisoners, exemplifies a heritage site that embodies both architectural value and historical trauma. The Corfu Prison should be recognized as it deserves, as a prominent monument of the Resistance and the Struggle of the people of Corfu, the Ionian Islands, and all of Greece against social injustice.

The building still functions today as an active detention facility. Following the cessation of wing Θ, the site stands as a monument of historical memory, requiring meticulous documentation for conservation, interpretation, and public accessibility. By employing terrestrial laser scanning to create a high-accuracy 3D model and publishing the results online, this paper aims to contribute to the growing body of work at the intersection of digital heritage, political history, and virtual memorialization. Through the creation of an interactive digital environment, users will be able to explore the cells and corridors virtually, gaining insight into the spatial realities of confinement while ensuring the site's long-term preservation in digital form.

2. CASE STUDY

Following 1453, the Ottomans steadily extended their authority over the remaining Greek territories they had not yet subdued. The Ionian Islands—except for Lefkada, which belonged to the Ottoman Empire for roughly two centuries—largely avoided Ottoman rule. Corfu, the largest of the islands, never came under Ottoman control. The Ionian Islands remained Venetian possessions until 1797 and thereafter successively fell under French, Russian, and British influence, becoming a British protectorate from 1815 to 1864, when they were finally incorporated into the Kingdom of Greece. Apart from the city palace, the most substantial structure the British left behind in Corfu during their nearly fifty years of protectorate rule is the “Sofronisterion”, i.e. the Correctional Prison of Corfu. This was the name given to the prison constructed by one of the High Commissioners of the British administration in the Ionian Islands, Sir Arthur Douglas, whose tenure became linked with the realization of extensive public works projects.

Most prisons in Greece were originally older buildings that had served various functions, including castles. For instance, Acronafplia was a medieval fortress that later became a military hospital and eventually a military camp. The prison on Aegina began as an orphanage in 1830 and was later used successively as an officers' academy, a quarantine station, a psychiatric clinic, a refugee shelter, and finally, in the 1880s, as a prison. Izzeddin started as an Ottoman fortress (1866–1869) before being converted into a prison in 1898. The prison in Pylos had functioned as an Ottoman fortress since 1573. Greece gained its first purpose-built prisons with the annexation of the Ionian Islands, when the British-established prisons from the late 19th century were transferred to the Greek state.

During the Venetian occupation, the island's defensive strategy relied heavily on the formidable fortifications of the city, designed to keep it secure against any potential invaders. The city was therefore dominated by imposing forts and bastions, making Corfu virtually impregnable, yet also a tightly enclosed, heavily fortified settlement, with little room for urban expansion. In the first half of the 18th century, Field Marshal Schulemburg added to these defenses by constructing a fort on the hill of the Sotiros (Forte San Salvador) (Figure 1). Under British rule, up until 1839, the Fort of the Sotiros was demolished, and on the cleared site, prisons were erected. These were designed with a radial layout and projecting wings, and many of the construction materials came from the dismantled fort.

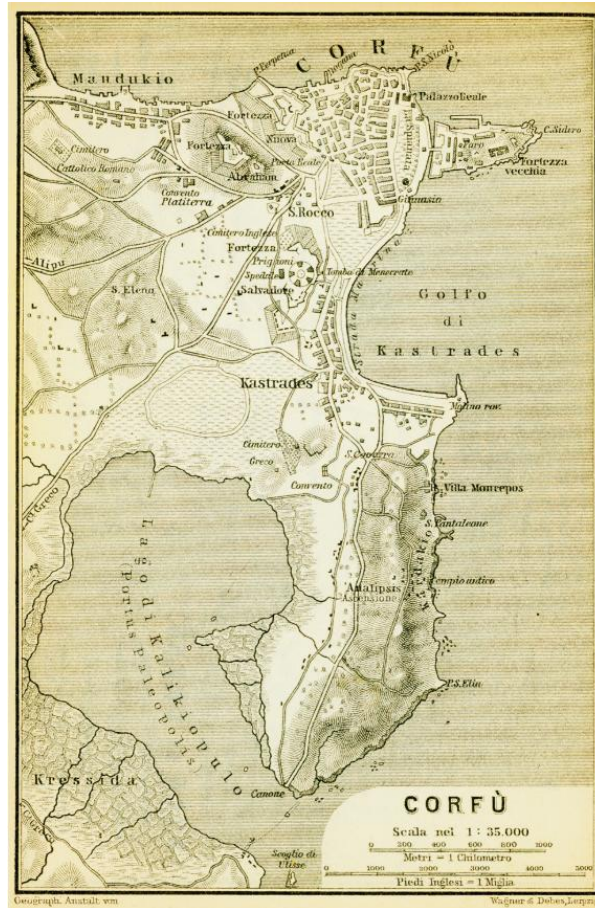


Figure 1. Map of the city of Corfu from the 1894 edition of Baedeker's guide [14].



Figure 2. An aerial photograph from 1917 showing the correctional facility and surrounding fields [15].

The Corfu prison complex was built in the first half of the 19th century, with its foundation stone laid on April 19, 1840 [1]. During the ceremony, the High Commissioner gave a speech in which he expressed pride in the project, emphasizing that the region needed strong prisons to restrain those who resisted foreign authority [15]. Over time, the facility gradually transformed into a political prison, officially changing its name from “Correctional Prison” to “Criminal Prison”, and later simply “Prison” [16] (Figure 2). Between 1936 and 1974, it held numerous political detainees under the Metaxas Dictatorship, the Occupation (2nd World War), the Civil War, and the April Dictatorship.



Figure 3. Gradual change of name: (a) Corfu Criminal Prisons [17] and (b) Corfu Prisons [18].

The British Prisons of Corfu constitute an example of modern architecture, diverging from the quadrilateral prison structures that had predominated until that time. Their design follows the American model of the radial prison, itself a variation of the British-inspired Panopticon. The central edifice evokes the prototypical panoptic structure as conceived by J. Bentham, though it does not replicate it faithfully, as the Panopticon follows a circular design, while the Corfu prisons are organized according to a radial layout (Demopoulos 2003); nonetheless, the influence is both strong and evident.

The complex is organized into four concentric circles. Radiating wings extend outward from a central circular building—colloquially referred to as the “bagel”—which features ten windows on each storey. The ground level, technically a semi-basement, accommodated the workshops, the prison’s main workshop facility, the kitchens, and storage rooms. The first floor housed the administrative offices and the clothing depot, while the second floor contained a chapel. The remaining three circles consist of perimeter walls: the two inner walls incorporate metal railings, whereas the outermost wall, which encloses the entire complex, reaches a height of seven meters and contains three masonry guard towers equipped with interior staircases but accessed from outside the compound. This arrangement is unique among prison buildings, as the external guard posts are entered directly from the street rather than from the yard or the inner moat, as is customary elsewhere.

Although the layout aligns with Bentham’s philosophy of panopticism, enabling oversight of the entire facility from the central tower, the structure does not constitute a true panopticon, as it does not permit direct surveillance of each individual cell, but only of the radiating wings [1] (Figure 4).

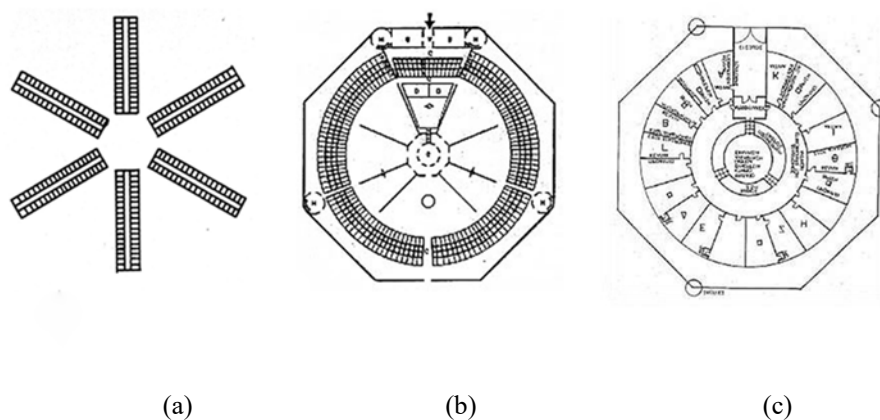


Figure 4. (a) Radial arrangement [19], (b) first western penitentiary in Pittsburgh [19] and (c) floorplan of Corfu prison building 1947-1949 [20].

The prisons of Corfu are among the earliest examples of a hybrid architectural model combining features of the American “Eastern State” penitentiary in Philadelphia—constructed in 1829—with elements of the Panopticon. As in Philadelphia, the Benthamite arrangement is displaced from the

perimeter and reorganized into radiating wings. Yet, whereas the American prototype ultimately adopts a quadrilateral plan, the Corfu prison—built only a few years later—assumes a wheel-like configuration, with an overall octagonal layout (Figure 5).

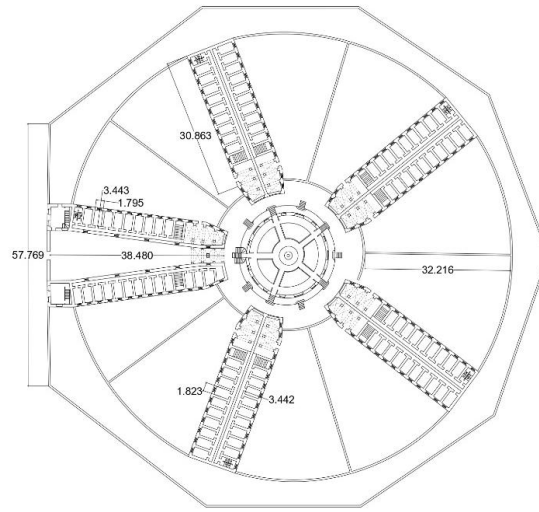


Figure 5. Floorplan of Corfu Prison (Authors).

The prison complex follows the “radial” architectural paradigm, in which the cell blocks are arranged as spokes extending from a central hub, enabling surveillance of all wings from a single vantage point. This building type was designed to meet the requirements of the new penal system, specifically:

- enhanced security and oversight, achieved through an enclosed structure free of blind corners beyond the guards’ field of vision;
- classification and segregation of inmates, enabled by self-contained units and individual cells.

The structure itself was octagonal, consisting of five wings, each subdivided into two radiating corridors. There were therefore ten detention wings in total, arranged on two levels and designated by the letters A through K. Each wing contained 23 cells—nine on the ground floor and fourteen on the upper floor—amounting to 228 vaulted single-occupancy cells.

Each wing functioned autonomously, with its own entrance, stairway, shared spaces (located at the front of the wing and used partly as workrooms), and two latrines—one inside the wing and a second in its adjoining yard. These spaces were connected by a corridor running along the inner long side of the core structure. Each wing also enjoyed an independent yard, formed by the interstitial spaces between the rectangular projections of the building.



Figure 6. Corfu Prisons, oil on canvas by Asadour Baharian, 1972 [21].

The cells had vaulted ceilings and measured roughly 3 by 2 meters, with the height at the apex reaching about 3 meters. Ventilation was achieved through air shafts positioned high on the exterior wall. Each door was fastened with bolts and a lock and included a small hatch at the top (Figure 7).



Figure 7. Typical Wing Θ cell: (a) view from the entrance toward the interior, (b) view from the interior toward the entrance, and (c) detail of the cell door (Authors).

3. METHODOLOGICAL FRAMEWORK

For the 3D documentation of Corfu Prison, terrestrial laser scanning (TLS) was conducted using a Leica Geosystems BLK360-G1 compact imaging laser scanner to obtain detailed geospatial records of the monument. This instrument offers the advantage of capturing an object's geometry, texture, and intensity. The strategic distribution of the scan positions and the registration path followed are illustrated in Figure 8. All scans were acquired at high resolution (4 mm step), with the scanner positioned no more than 5–10 meters from the structure in each setup. Each scan position required approximately six minutes.

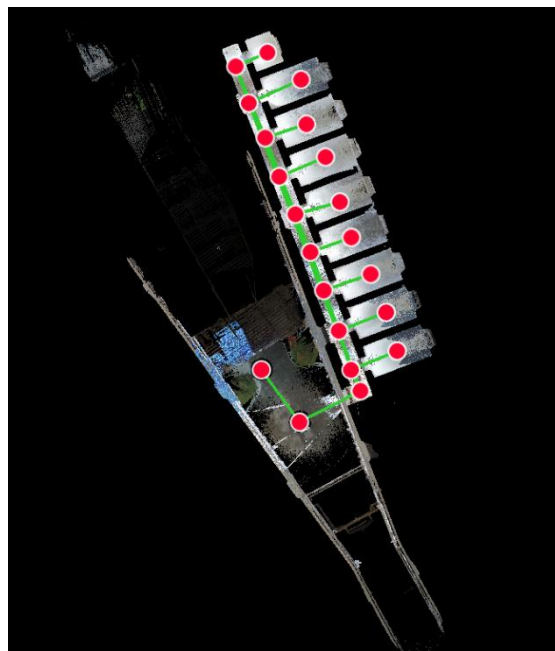


Figure 8. Top view showing the distribution of the 3D laser scanner positions (Authors).

Scan overlaps ranged between 40% and 69%, ensuring robust geometric consistency in the resulting model. The point clouds were processed using Leica Cyclone Register 360+, where individual scans

were aligned through tie points within an independent reference system. The large number of scan positions and the high degree of overlap resulted in a root mean square error (RMS) of 3 mm for the final registered point cloud (Figure 9).

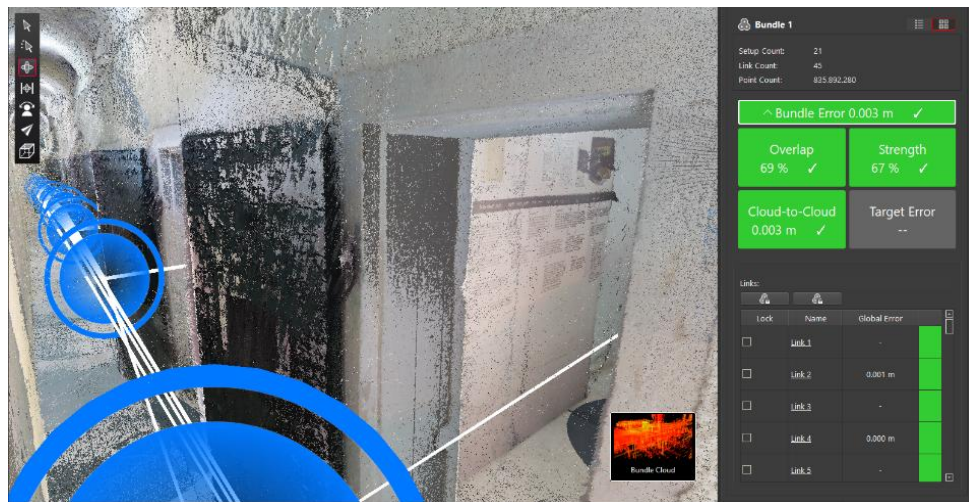


Figure 9. Total bundle error (Authors).

From the combined point cloud, various derivative products were generated, including a meshed model. Data acquisition was completed in a single day by a Surveying Engineer experienced in similar documentation projects.



Figure 10. True View environment (Authors).

The Corfu Prison point cloud was imported into the TruView Enterprise software (Figure 10). This platform enables users to conduct a virtual tour of the monument and perform measurements of dimensions, angles, and even the temperature of individual materials recorded on the day of data acquisition. Regarding image texturing, a 3D model was generated (Figure 11) and, once finalized, was imported into the platform.

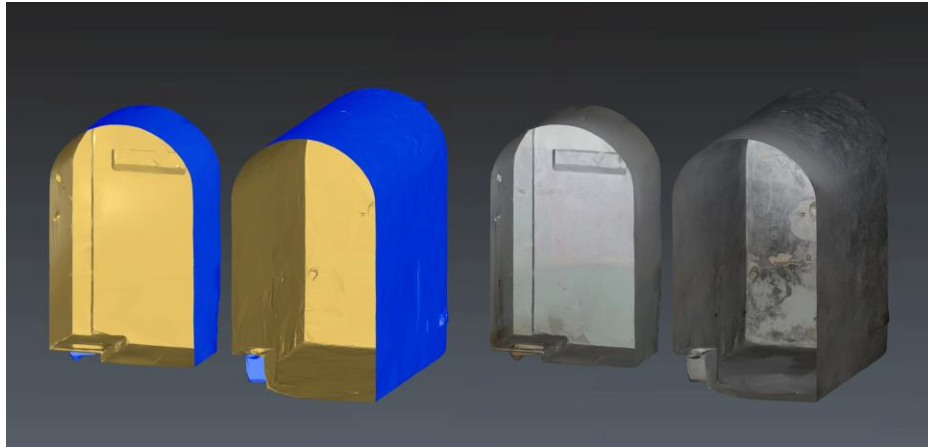


Figure 11. Mesh and Image textured model (Authors).

4. WEB PLATFORM DEVELOPMENT

A web-based virtual tour platform was developed to support the documentation and dissemination of the Corfu Prison, using the 3D Vista Virtual Tour Pro software. The platform is freely accessible (<http://195.130.106.60/CP/>) and provides users with interactive map views and access to high-quality spatial data, facilitating research activities, public engagement, and informed decision-making (Figure 12).



Figure 12. Virtual tour in the Corfu Prison via web platform (Authors).

One of the main advantages of incorporating 3D models into virtual tours is their ability to present properties and heritage assets in a realistic and immersive manner. This tailored configuration enables the efficient storage, management, and retrieval of comprehensive metadata related to the Corfu Prison. The geospatial content within the platform is organized into six thematic layers:

- Info
- Oral histories – Storytelling
- Photos
- 3D model
- Virtual tour
- E-learning

The web platform interface serves as the primary access point to this extensive geospatial repository, offering intuitive tools for both general users and specialized researchers. Designed with a bilingual interface (Greek and English), the platform accommodates diverse user groups while ensuring consistent functionality across both language settings.

5. DISCUSSION

For the digital documentation of the Corfu Prison, advanced equipment and methodologies were employed, encompassing both high-resolution laser scanning for precise measurement and contemporary visualization approaches through web-based platforms and virtual reality (VR) technologies. This section examines the project's theoretical and methodological foundations, situating it within an international context to highlight its broader significance. The discussion is structured around two complementary pillars: first, its contribution to cultural heritage preservation, and second, its alignment with a global shift toward integrating immersive digital environments into the study of dark or negative heritage.

The 3D model developed for the Corfu Prison is not only highly accurate and interactive but also represents an innovative approach to the representation and dissemination of heritage knowledge. Platforms such as 3D Vista extend beyond conventional visualization tools, functioning instead as interpretative frameworks that enhance historical understanding. The Corfu Prison project, alongside comparable initiatives such as MayaArch3D [22] and the Open-Source Web Platform for 3D Documentation [23], employs storytelling, spatial interaction, and three-dimensional modeling to make heritage content accessible not only to specialists (e.g., archaeologists, engineers, conservators) but also to the wider public.

Concurrently, the Corfu Prison project supports remembrance, aligning with initiatives such as CyArk's Open Heritage 3D Project. By digitizing vulnerable or restricted spaces and providing access through immersive online experiences, such efforts respond to increasing accessibility challenges while democratizing cultural heritage engagement [24]. Features including interactive hotspots, embedded narratives, and panoramic 3D views extend beyond mere simulation, fostering inclusive and globally accessible modes of heritage interaction.

The integration of the 3D model into a web-based platform further enhances its analytical and interpretive capabilities. Similar to digital documentation projects in Oman, where spatial layering enables the examination of archaeological remains in relation to topography and urban development [25], the Corfu Prison case study facilitates a relational understanding of space and offers new perspectives on the evolution of the prison's architectural landscape.

A key innovation of this project is the incorporation of a VR tour using the Meta Quest 2 headset, extending the platform into fully immersive virtual environments. This development underscores a broader shift in the pedagogical and experiential dimensions of digital heritage—from screen-based interaction to embodied immersion (Figure 13). Through this application, the management and spatial experience of the Corfu Prison become almost tangible to a global audience.



Figure 13. Virtual Reality tour test of Corfu Prison (Authors).

Overall, the platform provides an integrated and adaptable representation of the Corfu Prison, addressing the needs of diverse user groups, including tourists, students, researchers, conservators, and engineers. The importance of such virtual experiences is particularly noteworthy, as they transcend physical and geographical constraints, expanding public access and understanding. Moreover, the project demonstrates the potential of immersive digital technologies to safeguard cultural heritage and enhance educational outreach, establishing a benchmark for future initiatives in the preservation of dark heritage.

Taken together, these elements illustrate that the digital documentation of the Corfu Prison is not an isolated endeavor but part of broader theoretical and methodological developments in virtual heritage. By situating this case study within an international framework, the project highlights the capacity of immersive technologies not only to preserve the past but also to reshape how cultural heritage is interpreted, experienced, and shared in the present.

6. CONCLUSIONS

Dark heritage addresses troubling and often uncomfortable social histories, in contrast to the heroic or progressive narratives traditionally emphasized by museums and cultural heritage institutions—narratives that, at times, have leaned more toward idealization than critical interpretation.

Although digital heritage initiatives are increasingly widespread, they tend to concentrate on well-known or well-funded sites, frequently leaving regionally significant yet culturally valuable locations digitally underrepresented. This imbalance is particularly evident in the context of dark heritage, where lesser-known sites often encounter greater obstacles in adopting digital tools. The issue is especially relevant in countries such as Greece, whose cultural landscape is exceptionally rich but remains partially underutilized in digital heritage strategies.

This study highlights and promotes the significance of the Corfu Prison, a regional heritage complex located on the island of Corfu in the Eptanisa region of Greece. Characterized by layered historical phases and diverse architectural remnants, the prison provides an ideal case for integrating high-precision digital documentation with community-oriented heritage planning. The methodology is comprehensively presented, from the initial stages of historical research and geometric data acquisition to the integration of results into a web-based platform offering tailored functionalities for diverse user groups.

Using advanced techniques and high-end equipment, such as terrestrial laser scanning (TLS), high-precision 3D model of Wing Θ within the prison complex were produced. The resulting digital deliverables achieve an average accuracy of ± 1 cm and are suitable for multiple applications across different disciplines. Indicative examples include:

- Architectural and structural analysis: precise dimensional data supporting architectural studies, conservation planning, and restoration projects, as well as the generation of drawings such as façades, floor plans, and horizontal and vertical cross-sections.
- Material condition assessment: visualization and documentation of the monument's pathology derived directly from the 3D models.

Beyond documentation, a web-based platform was developed to promote and disseminate the Corfu Prison. The platform is freely accessible (<http://195.130.106.60/CP/>) and functions as a central hub for visualization, interpretation, and data access.

The final phase of the study involved the creation of a VR tour integrated into the platform, supporting not only heritage visualization but also educational engagement, participatory planning, and the management of remembrance.

The platform may be utilized by local authorities and the Ministry of Culture as a tool for promoting this historically significant site, as well as by educational institutions at both school and university levels. Through VR experiences and interactive storytelling, learning becomes more engaging and accessible to users of all ages.

Furthermore, the platform enhances accessibility for both researchers and the general public. By enabling virtual exploration of the prison, it offers an immersive experience that reduces the physical wear and deterioration associated with on-site visitation.

From a decision-making perspective, the platform can also support urban and heritage planning processes, such as the development of master plans, evacuation scenarios in cases of flood or fire, and the design of circulation and signage systems.

The implementation of comprehensive 3D digital geospatial documentation through a web-based platform at the Corfu Prison demonstrates a successful integration of heritage conservation and remembrance. This approach provides a transferable model for similar heritage sites seeking to balance public accessibility with the responsible interpretation of complex historical narratives.

Future work will focus on two primary directions. The first involves the creation of 3D models encompassing the broader Corfu Prison–Lazareto Island complex, enabling users to experience the site as an interconnected historical landscape. Lazareto, a small islet near the port of Corfu, was used as a site of mass executions. Condemned prisoners, primarily inmates of the Corfu Prisons and mostly Communists, were led to the execution wall on the islet. According to testimonies, at least 200 resistance fighters were executed there by September 1949.

The second direction concerns the further development of the web platform and VR experience, including qualitative and quantitative studies of user interaction across different groups (e.g., tourists, students, and local communities). Additional research avenues include the development of mobile-friendly and augmented reality (AR) components to expand both on-site and remote access, as well as the evaluation of how mixed-reality experiences influence visitor behavior, knowledge acquisition, and cultural appreciation.

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