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THE ROLE OF DIGITAL TECHNOLOGIES AND DARK TOURISM IN PROMOTING AND PRESERVING CULTURAL HERITAGE: A CASE STUDY OF DIGITIZED FUNERARY ARTWORKS FROM ȘERBAN VODĂ BELLU CEMETERY

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Abstract

The integration of digital technologies in cemetery management and its relationship with dark tourism offer opportunities for enhanced accessibility, preservation, and commemoration of cultural heritage. This study examines the intersection of digital cemetery management and dark tourism, focusing on the digitization of select funerary artworks by Karl, Carol, and Frederic Storck in the Șerban Vodă 'Bellu' Cemetery, Bucharest, Romania. These artworks, emblematic of the artistic style prevalent at the turn of the late 19th and early 20th centuries, serve as a focal point for exploring the potential of virtual access to cemetery sites in attracting dark tourism interest and facilitating engagement with cultural heritage. Special attention is given to the "Bellu Cemetery—Open Air Museum" online platform, but the focus is on the artwork digitization process. The paper details the capturing method and the workflow of the 3D mesh model generation and optimization to ensure a seamless interactive online experience. Two artworks attributed to Karl Storck, one from Frederic Storck, and 9 from Carol Storck are being discussed. By explaining key elements of dark tourism and its virtual dimensions, this research aims to contribute to a deeper understanding of the evolving relationship between technology, cultural heritage preservation, and tourism experiences.

***Keywords**: Funerary art; Cemtech; Dark tourism; Virtual heritage; 3D digitization; Digitalization; Cultural heritage*

Introduction

About the dark tourism

Even though the concept of „dark tourism" was only defined at the end of the last century, travelling to places associated with death is not a new phenomenon, having been practiced since the earliest times of human history. One of the first manifestations of dark tourism can be linked to the bloody contests between gladiators in the Colosseum that gathered large crowds of people from all corners of the Roman Empire [1]. Other precursors of dark tourism can be considered the pilgrimages to holy sites, the public torture and execution events that took place from the Middle Ages up until the 19th century, or the guided tours of the morgues and catacombs of Paris from the 19th century, which attracted substantial audiences [1, 2].

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Dark tourism is a popular topic nowadays, with an increasingly accelerated development that has attracted both the attention of several researchers in a wide range of fields and disciplines beyond tourism studies and tourism management, as well as the attention of the mass media [3].

Before the term “dark tourism” was defined, many other researchers had studied the relationship between tourism and death, labelling this phenomenon as “Black spot tourism” [4], “Thanatourism” [5], “Atrocity tourism” [6], “Sensation sights” [7], or “Milking the macabre” [8]. The concept of "dark tourism" was introduced in academic research in 1996 by Malcom Foley and John Lennon in a themed edition of the International Journal of Heritage Studies. In their vision, dark tourism is defined as “the presentation and consumption (by visitors) of real and commodified death and disaster sites” [9]. Advancing on the thematic, other authors studied the subject, adding new definitions and information. Based on the new research, dark tourism is a form of niche tourism, considered by many authors as a subset of cultural and heritage tourism [3, 10, 11], demolishing the classic definition of tourism as "traveling for pleasure" [12]. Dark tourism represents the activity that allows the visitors to face death, tragedies, disasters, or other dark aspects of human history, involving a higher or lower dose of macabre, pain, and suffering, whether historical or emotional, and having emotional significance for individuals, serving purposes such as commemoration, education, or leisure [13].

In addition to the academic interest in dark tourism, the concept also gained popularity due to the 2018 Netflix documentary “Dark Tourist,” which follows the adventures of the journalist David Ferrier, who visits the most unusual and macabre spots in the world.

To make a distinction between dark tourism’s sites, Stone [1] created the spectrum of dark tourism, which offers a comprehensive understanding of the diverse attractions within dark tourism, categorizing them based on the level of “macabreness” and emotional engagement they offer. He realized a gradual transition from the darkest pole of the spectrum, which involves authentic sites of death and suffering, to the lightest one, which involves only sites associated with death and suffering. The darkest pole includes a higher political influence, is an authentic location, has an educational purpose, uses traditional interpretation methods, and promotes a commemorative approach to the heritage in order to help the tourists to understand and cope with the past tragedies (e.g., Auschwitz-Birkenau Memorial and Museum), while the lightest pole includes a lower political influence, is an inauthentic location, has a commercial purpose, uses dynamic interpretation methods, and promotes an entertaining approach to the heritage in order to help the tourists to learn about the dark past in a fun way (e.g., London Dungeon) [14]. Stone [1] also suggested creating seven categories to analyze the different attractions associated with dark tourism based on their level of darkness: Dark Fun Factories, Dark Exhibitions, Dark Dungeons, Dark Resting Places, Dark Shrines, Dark Conflict Sites, and Dark Camps of Genocide.

For a long time, the reasons why people choose to visit dark tourism destinations were little known; only since the mid-2000s have more and more authors approached this subject in their research. Recently, Light in his article [3], named “Progress in dark tourism and thanatourism research: An uneasy relationship with heritage tourism”, managed to identify the reasons that drive tourists to practice dark tourism, creating a long list of motives in order of how frequently they were identified in academic studies, including: educational propose; curiosity; connecting with one's personal or family heritage; to create a connection; understand what happened better; leisure motives; pilgrimage; passion for history; commemoration; sense of moral duty/obligation; interest in death/morbid curiosity; because it was a part of an planned itinerary; for national identity; because it is a ‘must see’ site; to honor personal ancestors; desire for contact and connection with death/dark events/violence; to see a famous site associated with death; to spend time with friends; to help with disaster recovery and other motivations.

The most mentioned reasons were educational purpose and curiosity. Many visitors are drawn to dark tourism sites for educational reasons, seeking to gain a deeper understanding of historical events, human suffering, and their broader societal implications. These tourists are often motivated by a desire to learn and reflect on the past. Also, some tourists are attracted to dark tourism sites out of curiosity, these destinations offering opportunities for individuals to satisfy their interest while confronting uncomfortable truths about human history and resilience.

Romania, a country located in southeastern Central Europe, stands as a dark tourism destination due to its recent past marked by tragic political events, as well as its rich heritage and folklore that attract visitors eager to explore its dark aspects.

The spectrum of tourist attractions in Romania is diverse, containing both sites that belong to the darkest pole, such as attractions associated with war tourism, Holocaust tourism, red tourism, or cemetery tourism, as well as locations that belong to the lightest pole, such as attractions associated with the tourism of Dracula and paranormal tourism.

Evolution and significance of funerary art

For centuries, people have felt the need to commemorate the departed through memorials. Funerary sculpture, as an artistic expression, has evolved in different cultures and historical periods, reflecting religious and cultural beliefs as well as advances in artistic techniques and tastes.

Depending on the period and cultural context, trends in funerary sculpture have varied significantly. In certain periods, such as Greek antiquity or ancient Rome, funerary monuments were elaborate and richly ornate, reflecting a belief in the immortality of the soul and a desire to honor one's ancestors [15]. Sculptures of the time often depicted mythological scenes or portraits of the deceased, emphasizing the importance placed on memory and posterity.

In the European Middle Ages, funerary sculpture underwent significant changes, reflecting changes in the religious and social beliefs of the time [16]. Funerary monuments of this period were dominated by Christian influences, and religious motifs, such as biblical scenes or depictions of saints, were prevalent. Many of these monuments were often in the Gothic style, with intricate detail and a solemnity that reflected the view of life and death of the period.

In later periods, such as the Renaissance and the Baroque period, funerary sculpture experienced a renaissance in many parts of Europe [17]. Funerary monuments again became elaborate expressions of wealth and power. Artists sought to create works that combined aesthetic beauty with symbols of the power and social status of those commemorated.

Funerary sculpture was and remains an important form of artistic expression, reflecting not only the tastes and technologies of the age but also the human relationship to death and memory. Regardless of the prevailing fashion or style of a particular period, funerary monuments remain enduring testimonies to human love and respect for those departed in eternity, from classical and elegant to contemporary and abstract creations.

Șerban Vodă "Bellu" cemetery

The "Șerban Vodă - Bellu Cemetery" (Fig. 1) ensemble is inscribed in the List of Historical Monuments 2010—Municipality of Bucharest—at no. 22438, LMI code B-IV-a-B-20118. The cemetery is located in what is now the larger central area of Bucharest, on Șerban Vodă street. At first this location was outside the city, but as the city grew over the years, it remained in a central area of what is now Bucharest. The precise cemetery foundation date is not known, but evidence points to somewhere between 1850 and 1859 [18]. The oldest cross in the cemetery dates to 1851, while the first official documents show C.A. Rosetti and Cezar Bolliac as the first concession holders in 1859 and 1860, respectively. In the same study, Bezviconi mentions that this location was an unusual place for parties before 1879, and perhaps this was the reason why the locals made the habit of visiting the "Bellu cemetery" for other purposes than funerals, like field trips outside the city or just relaxation.

Bellu rapidly becomes one of the few cemeteries in Europe that concentrates famous people and officials, following the model of other similar cemeteries that are now landmarks for tourism: in France, the Pere-Lachaise cemetery [19] or Montmartre [20], and in Denmark, the Assistens cemetery [21]. Decades before "Bellu" was founded, many foreign artists and trends (especially Italian and French art schools) infused the Wallachia and Moldavia principalities with new ideas in architecture and art [22]. Royal and noble Moldavian and Wallachian families began ordering complex and imposing funerary monuments, setting a trend for later years for most rich families.

Fig. 1. Bellu cemetery entrance [23]

Today, "Bellu Cemetery" is renowned for its vast collection of art, not only funerary but also architectural, sculptural, and heraldic works, which enrich the cultural landscape of Romania. Among the outstanding architects who contributed to this site are Ion Mincu (1853-1912), one of the leading architects of his time; he is commemorated in the cemetery by a wooden trophy made by the architect State Bolosin and the sculptor C.M. Babic; and Ion Berindei (1871-1928); their works, together with those of other architects, made a significant contribution to the cultural landscape of this site.

In addition to these, the cemetery hosts an impressive variety of sculptures by Romanian and foreign artists who, throughout the cemetery's existence, have enriched the cultural archive of the Bellu Cemetery-Open Air Museum. Among the Romanian artists, we mention several of them with a selection of their works:

- Ion Georgescu (1856-1898), with his works: the bust of Iulia Hașdeu (1889), made of marble, a work that is currently at the Hașdeu Memorial Museum in Câmpina; the bas-relief of Mihai Eminescu (1889); Taranca, a life-size work from 1887, from the Papadopol tomb; the bust of the painter Constantin Lecca; and the medallion of his wife Victoria (1887).
- Dumitru Paciuria (1873-1932) with at least three works: The Head of Christ with the Crown of Thorns, The Assumption of the Virgin Mary, and the bust of the painter Petre Serafim.
- Karl, Carol, and Frederic Storck, who are also the focus of the case study for this research.
- Other artists: Ion Jalea, Milita Patrascu, O. Han, C. Baraschi, and Dimitrie Mirea.

Among the foreign artists we could name Raffaello Romanelli (1856-1928), whose descendants continue his work to this day, and who left us several works: The Lady with the Umbrella, the Elisaveta Pulieva monument, the Petru Stoicescu monument (1907), and the Poroineanu monument (1902). Other foreign artists are Auguste Preault (1809-1879) with his statue of Alexadrina Falcoianu (1873), Ernest Dubois, and others.

Unfortunately, by default, cultural heritage goods, especially outdoor elements such as cemetery artworks, are prone to damaging agents such as anthropic factors (vandalism, war, ignorance) and natural occurrences such as earthquakes, floods [24], and pollution. The Bellu cemetery has suffered significant losses, with many important artworks stolen or destroyed by earthquakes (1940, 1977) or wars. In a detailed analysis from 1958, Bezviconi G [18] highlighted the critical condition of many sculptures in the cemetery and stressed the necessity of a permanent program to protect them. Despite this, the efforts from officials to address these issues have been minimal over the years.

Cemeteries as places of life, culture, and education

For a long period of time, cemeteries had the primary function of providing a burial place for the deceased and offering a space of commemoration and remembrance for their families. However, in recent years, there has been a notable shift in the way cemeteries are perceived, with increasing recognition of their value as cultural and historical sites that offer unique opportunities for tourism.

Cemetery tourism, known also as “necrotourism,” is a niche subset of dark tourism that is becoming increasingly popular [1], involving the exploration and visitation of graveyards, mausoleums, and burial sites for leisure, educational, or contemplative purposes. It is a multifaceted experience that blends history, culture, and the macabre, offering tourists insight about the lives, deaths, and legacies of individuals and communities.

Cemeteries, like other heritage attractions, serve as educational resources, offering tourists a unique alternative to visit and discover the culture and history of a place [25]. Many tourists are motivated to visit cemeteries by the opportunity to delve into the rich artistic, architectural, and historical legacy preserved within these open-air museums [26].

In 2001, the "Association of Significant Cemeteries in Europe" (ASCE) was founded, an NGO that has as objectives promoting European cemeteries as fundamental parts of human heritage and increasing awareness of the historical, artistic, architectural, educational, and social value of cemeteries as important elements of European cultural heritage. The association contains 54 cemeteries, 42 cities, and 18 countries from Europe, including Romania [27].

Public and private organizations work together to promote cemeteries as cultural and historical attractions by organizing various events that engage visitors and raise awareness of the significance of these sites. Through cultural events, such as guided tours, exhibitions, concerts, workshops, film festivals, and many more, cemeteries are presented in a different perspective to visitors, emphasizing them as places of life, not places of death [28].

Digitalization and digitization’s role in cemeteries’ modern management and (virtual) dark tourism

Digitalization and digitization, despite their similar terminology, are two different concepts that occasionally intertwine. With the rise of the digital age, many business processes and workflows have been transformed by embracing the instantaneous and much more efficient digital tools like databases, customer relationship management platforms (CRMs), digital accounting tools, cloud storage, intranet platforms, and many more.

Digitization, on the other hand, is a very specific activity that results in the conversion of analog and physical information into digital format. In the digital transformation process for a business, digitization can be employed to scan all documents. In cultural heritage, digitization gained a crucial role in the last decade. Historical documents or old research sheets are scanned and stored in databases; photographs (on early mediums like glass, metal, or paper), film, and even wax cylinders now all have digital copies. Photogrammetry and laser scanning facilitate the transfer of real-world physical coordinates and shapes into digital format as point clouds or 3D mesh models.

For cultural heritage, especially after the pandemic, digitization became an essential tool for recording and dissemination of cultural goods in digital format over the Internet, making it accessible anywhere. Perhaps the most important role of digitization (and digitalization) in this sector is the preservation of precise digital copies of the shape and aspect of endangered cultural goods. Even so, the historical value of a lost artifact or destroyed monument cannot be replaced. A copy is just a copy of the shape and color (valuable information) of what once was but is devoid of cultural value and significance.

Digitization is usually part (but not all the time) of the digitalization transformations. 3D digitization of monumental structures is currently performed using two methods: photogrammetry and laser scanning. Either method will produce a point cloud from which 3D mesh models can be created. As it will be described, for this case study the digitization method used was photogrammetry.

The digitalization of cemeteries represents a relatively recent but rapidly evolving field, with early endeavors dating back to the late 20th century. Initial efforts focused on creating online memorials and virtual tours, primarily driven by individual families and memorial websites [29]. These early digital commemoration platforms laid the groundwork for more sophisticated technologies and practices in cemetery management.

One notable example of early digital cemetery technology is the introduction of the "Talking Tombstone" in the late 1970s, featuring built-in screens displaying multimedia content about the deceased [29]. This innovation, though primitive by today's standards, foreshadowed the integration of digital media into cemetery landscapes. Furthermore, the advent of Web 2.0 platforms in the late 1990s and early 2000s facilitated the proliferation of online memorial practices, allowing users to create and share tributes, videos, and personal messages in memory of their loved ones [29]. These early digital initiatives marked the beginning of a transformative shift in how societies engage with death, burial, and commemoration in the digital age.

On the other hand, virtual dark tourism, similar to virtual tours, has gained more popularity with the new accessibility opportunities offered by the new technologies. It has similar forms like virtual tourism, but given its thematic, it can offer access to otherwise inaccessible or endangered dark sites. Nicolae Basaraba argues that this form of dark tourism might be beneficial for the preservation of cultural heritage [30] by studying the effects of tens of YouTube channels dedicated to virtual dark tourism.

In parallel, early experiments with 3D modelling and GIS technologies in cemetery documentation and management laid the foundation for more advanced approaches to digitalizing cemetery landscapes [31]. While these early endeavors were often experimental and limited in scope, they paved the way for the development of comprehensive digital cemetery mapping techniques and preservation strategies in subsequent years [32]. In Romania, a notable effort was made in the 3D laser scanning of the Jewish Cemetery of Alba Iulia [33] for documentation and conservation/restoration purposes.

Despite the potential benefits of digital cemetery technologies, there is a divide in public opinion, with younger generations generally more accepting of these innovations [34]. The clash between tradition and technology in cemeteries has sparked debates over the use of digital media and online memorial practices. Fraser et al. also introduces the term “cemtech,” referring to cemetery technology.

The advantages of the digital workflows in the management of cemeteries (as in any other business) are undeniable. Cemeteries like Mount Auburn [35] (Massachusetts, USA), Green-Wood [36] (New York, USA), Glasnevin [37] (Dublin, Ireland), or Bonaventure [38] (Georgia, USA), just to name a few, have already implemented such systems. In Romania, the Jewish Cemetery in Iași has its own virtual tour, allowing virtual visitors to hop from place to place within the cemetery [39], but without a database or any other burial information. With a digital workflow in place, it becomes trivial to develop a public user interface through a website to give access to virtual visitors to search information about the notable personalities and how to find them. Users can also find historical information, burial records, or even make virtual tours. In all the given examples, the management teams have shown a great awareness of the importance of access to information for both researchers and the public. They realized that such initiatives greatly contribute to the preservation and promotion of the cemeteries’ cultural and historical value.

“Bellu Cemetery – open air museum” digital platform [40]

The platform was created by NGO *Călător prin România* in 2021 due to the lack of an online centralized space where the public could access information about the personalities and artworks within the Șerban Vodă “Bellu” Cemetery. Ever since its launch, the platform has been very active, both on the online database and also on social media platforms, where it engages the public in a citizen science approach. There is minimal public information regarding the personalities (number) and lesser-known families buried in the cemetery. The NGO efforts in research are doubled by the public contributions during the social media interactions, where the platform has great support. The website features an interactive cemetery map where the users can click on a figure to access a dedicated page with photos, text, and, where they exist, embedded interactive 3D models of the monuments on that figure.

The NGO installed QR code cards on all figures throughout the cemetery (28ha). Once scanned, the codes take the user to the figure's dedicated description page. At the moment of writing this paper, there are 350 figures active on the platform.

The 3D digitization activities started in 2023 in collaboration with Luthonium – Virtual Heritage [41] and were focused on the most endangered artworks (theft or critical condition). The main purpose of the digitization was to both have a faithful digital replica of the monuments for documentation and to share with the public in an interactive manner the beauty of these artworks. This paper focuses on a selection of the digitized works, all of which were created by members of the Storck family.

The Storck family

The Storck family's artistic activity spans over a tumultuous period in Romanian history, a period marked with important political (the 1848 revolution, the union of the principalities of Moldavia and Wallachia in 1859, the first world war, the union of the newly formed Romanian Kingdom with the Transylvania principality in 1918, and the industrial revolution) and economical changes (the industrial revolution). Karl Storck (1826-1887), the senior of the Storck family, was a German artist that moved to Bucharest in 1849. Since 1862 he led for two decades the newly founded Sculpture School in the National School of Belle Arte in Bucharest. He was characterized as a peaceful man without national prejudices that took great care of his family, especially protecting his two sons and offering them high education.

Carol Storck (1854-1926) was the first son of Karl and studied sculpture in his father's workshop until 1870, when he left to study in Florence under Augusto Rivalta until 1875. Between 1876 and 1880, he studies at the Philadelphia School of Art. In 1880 he returns to Romania to work with his father. His brother Frederic, or Fritz, (1872-1942) was Ion Georgescu's student between 1888 and 1893. He also studies in München (1893-1897). In 1906 he becomes a professor at the National School of Belle Arte in Bucharest. In 1909 he marries Cecilia Cuțescu (another famous Romanian artist, of whom we'll only mention that she succeeded in promoting and imposing the secular mural painting of certain aesthetic value in the Romanian landscape). The two brothers often collaborated and grew the Storck brand. They were never involved in politics or war. The three of them created many artistic and educational associations, trying to add more and more value to the society.

Experimental part

Materials

The equipment used for image recording was a full-frame mirrorless camera, the Sony A7R3 (42 megapixels), handheld in most situations, shooting in manual with adapted parameters to each situation. Occasionally a 1.8m handheld monopod with a Sony wired remote or a 10m photography pole with the Sony imaging smartphone app. The lens is perhaps the most important element when talking about image quality in photography. Of course, all elements are important, but the lens can make or break the photo. For photogrammetry, good lenses must have minimal spherical aberrations and up to no chromatic aberrations. In this case study, the Tamron 28-75mm f/2.8 Di III VXD G2, launched in late 2021, was used. Di III stands for mirrorless mounts (Sony FE), while G2 states this is the second-generation lens. VXD refers to the Voice-coil eXtreme-torque Drive, the premium autofocus system from Tamron.

The processing workflow starts with image set organization on disk. The images are recorded in RAW format to allow the best options in the post-process stage, especially for color and white balance corrections or when inevitable shadows, highlights, and unwanted reflections occur. Having a good file organization is paramount when using hundreds (even thousands) of photos. Therefore, in this workflow the data is stored in several folders as such: raw_imageSet, edited_imageSet, project_folder, export_folder, and shareable_folder. For each image set (subject), the folder names are changed to reflect the subject. All the working parameters (from shooting to processing) are stored in a spreadsheet for evidence and future references.

Image processing involves the creation of a color profile from the ColorChecker image and applying it to the image set in work. White balance is also very important in this stage and is set based on the white balance card image. Working with large sets of images requires a fast workflow to apply all these changes at once. Adobe Lightroom was used in this case to batch edit the image sets and export them in JPEG format.

3D reconstruction was carried out using Agisoft Metashape PRO 2.0. Each image set underwent the same processing workflow. Image alignment, to determine camera positions with the generation of a Sparse Point Cloud, camera optimization (with tie point covariance estimation), and subject alignment in the scene in regard to the origin and the axes (Fig. 2).

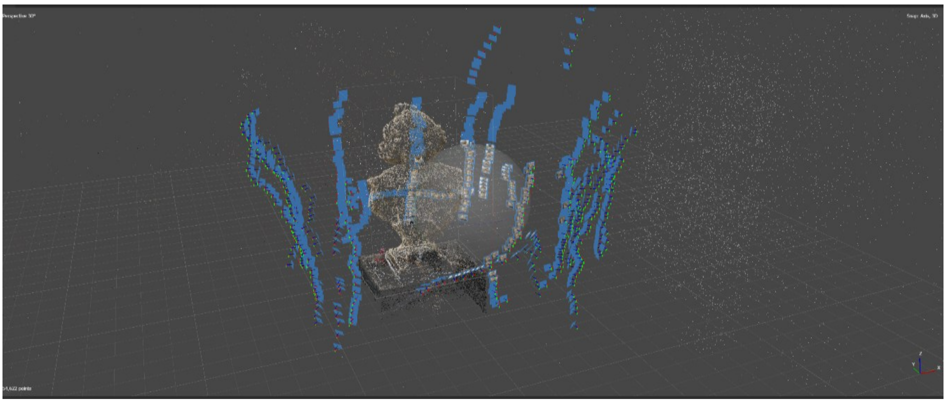

Fig. 2. Screen capture in Metashape: A sparse point cloud resulted after image alignment processing; the blue are the estimated camera positions.

The next step is mesh model generation, or the 3D geometrical surface reconstruction. The Depth Maps method was used at high settings for all the subjects. After this stage the scene is cleaned to leave only the mesh. In most cases only the bust sculpture was of interest, leaving the pedestals or supports aside (Fig. 3).

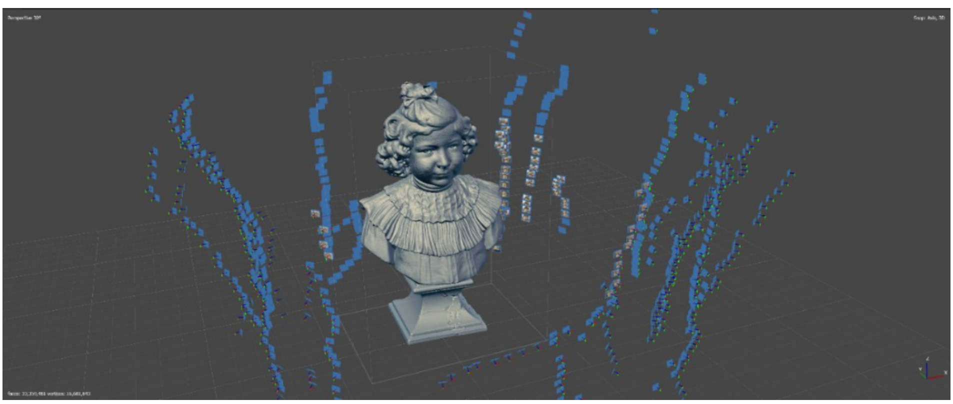

Fig. 3. Screen capture in Metashape: Mesh model

To publish in an interactive online medium, the mesh models must be optimized. The resulting meshes count between 30 and hundreds of millions of polygons. There are many methods to achieve this; our method involved decimation in Metashape down to 10,000 polygons and texture baking in Adobe Substance Painter to retain the details from the high-poly model. Color textures are generated with Metashape, usually at 8192×8192 pixels. In some special cases where the subject displays more than one material (like marble, stone, metal or wood), custom roughness and metalness textures might be created for a realistic online rendering.

Figure 4 depicts the difference made by a normal map baked from high-geometry meshes when viewed in renderers. This is the bust of Iulia Mulțescu, made by Carol Storck in 1907. The original mesh was generated from 716 images and had 37 million polygons. Of course, such complex geometry cannot run seamlessly in an online renderer. In this example the mesh was simplified to 10,000 polygons, with results seen in position A of figure 4. Using a color texture might mask the poor geometry. But for a truly useful experience and exploration of the details of the surface, all the geometry should be presented. Position B of the same figure shows the same mesh but with a baked normal map from the high-polygon mesh. Normal maps are special textures that tell the renderer how the light should bounce off the surface. This method allows the presentation of complex geometries in an easy and fast-loading manner.

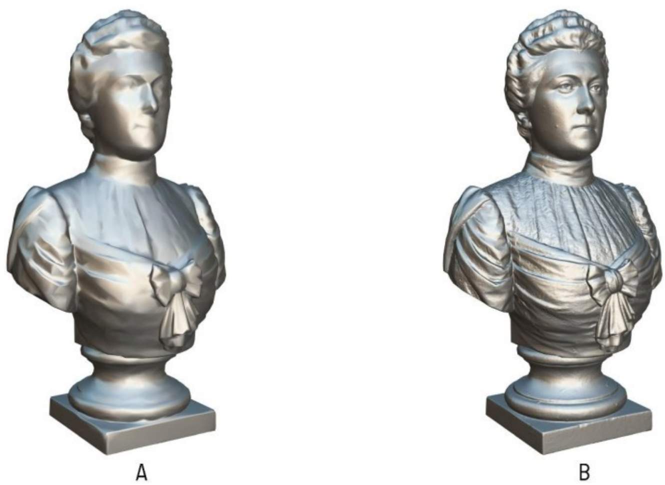

Fig. 4. A low-poly decimated mesh at 10,000 polygons. B-same mesh with normal map baked from high poly

The models are published publicly on the Sketchfab platform [44] accompanied by detailed metadata (title, description, artist, and where there is enough information about the deceased) and paradata information (recording date, method, raw data details, processing, and post-processing methods), according to international recommendations.

Methods

The first step in 3D digitization of a cultural heritage asset, such as the funerary monuments, is to assess the location, size, material, and purpose of the process. The purpose of the process will dictate the spatial resolution needed for the final 3D mesh model, meaning the working parameters for any of the used methods. If the purpose is to capture a large area with many monuments but with lower model quality, aerial scans with LIDAR or photogrammetry or terrestrial laser scans can quickly achieve this. In this case the prerequisite was to record in high detail each monument, emphasizing those with carving markings or artist signatures. The materials used for these types of monuments are usually stone or marble. Marble is known to be problematic for laser scanning due to its subsurface light scattering [42]. The small monuments, like busts, urns, or statues, have sizes varying between 1.5m up to 3m. While photogrammetry uses only a camera that can be mounted on poles up to 10m, laser scanners have limited access to the top of such high subjects. The only solution is to climb the scanner on higher platforms, which can be cumbersome, especially considering the location of these monuments. Bellu cemetery's monuments are distributed in a green environment, a space filled with trees and a lot of vegetation. Many of the monuments are completely covered with overgrown vegetation, while others are right next to big trees with very limited access for solid tripods. For most cases photogrammetry was the only viable option for 3D documentation, so this was the method chosen for the digitization of the cemetery's sculpted artworks.

The second step in the 3D digitization process is the workspace setup. While laser scanning is not dependent on the light and atmospheric conditions, photogrammetry is. Light is the key ingredient in photography, making it directly responsible for the quality of the image. Good-quality results in photogrammetry depend on image clarity, lack of shadows, and an optimal shooting strategy [43]. In cultural heritage 3D documentation, color correctness is paramount, as is the use of precise scales. ColorChecker and white balance cards were used for each monument, and coded target scale bars were used for adjusting the scale during data processing. Overcast days were prioritized for shooting, and when that was not possible, a big 2.5×2m light modifier was used to keep a constant and uniform shade over the surface.

Results and Discussions

In this section are presented the results of the 3D digitization of a selection of artworks attributed to the three Storck artists. The recording and processing methods are presented in the previous sections; here we are just exploring some of the details of each monument.

Karl Storck – monument for Elena Isvoranu (d. 1874)

Although the sculpture is not signed, it is attributed to him. It is made of white marble and is sized 1.86×0.55×0.55m. The statue was digitized in December 2023 from 1138 images, generating a high-poly mesh model of 162 million polygons. It is published online [45] at 127,000 polygons with color and normal map textures at 8192×8192 pixels.

Elena Isvoranu (b. Butculescu) was the mother of Aristita Bolliac, wife of Cezar Bolliac. Her father (Fig. 5), Marin Butculescu, a wealthy boyar (nobleman) and landowner in Olt, married her in 1830 to Alecu Isvoranu, with whom she had 24 children. Alas, only eight of them survived, the others being crushed in their sleep by their nanny, an unusually overweight woman, as the papers of the time mentioned.

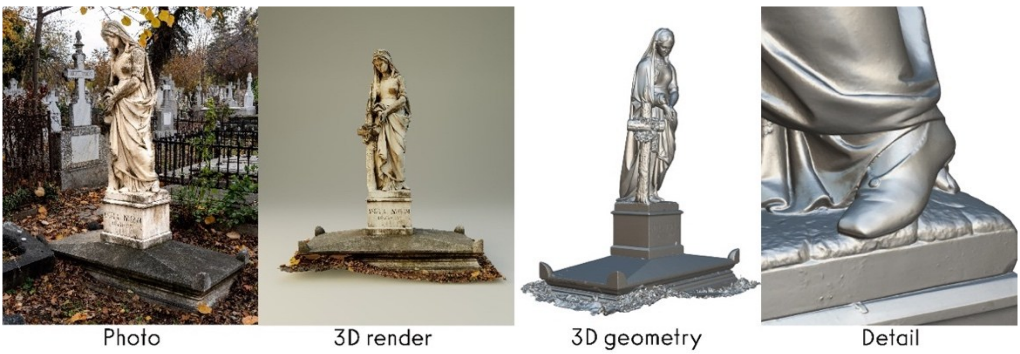

Fig. 5. Elena Isvoranu sculpture by Karl Storck (1874)

Karl Storck – statue for Elisabeta Bassarabescu (d. 1871)

Perhaps one of the most spectacular artworks in the cemetery, this one is also attributed to Karl Storck, even though there is no signature (Fig 6). The statue measures a bit over 1 meter in height and was severely damaged during the 1977 earthquake, falling from its pedestal. The head got detached on impact and was lost in time afterwards. Today, the statue lies on the ground near the pedestal, covered by vegetation. It is sizes 1.07×0.50×0.34m.

Fig. 6. Lady with veil by Karl Storck (1871)

The statue was digitized in March 2024 from 851 images, generating a high-poly mesh model of 84 million polygons. It is published online [46] at 10,000 polygons with color and normal map textures at 8192×8192 pixels.

Frederic Storck – bust of Ion Danabassi (1912)

Made of marble and sized 70×61×37cm. The bust is signed on the left sleeve with “Fr. Storck 1912” (Fig. 7). The bust was digitized in February 2024 from 630 images, generating a high-poly mesh model of 34 million polygons. It is published online [47] at 10,000 polygons with color and normal map textures at 8192×8192 pixels.

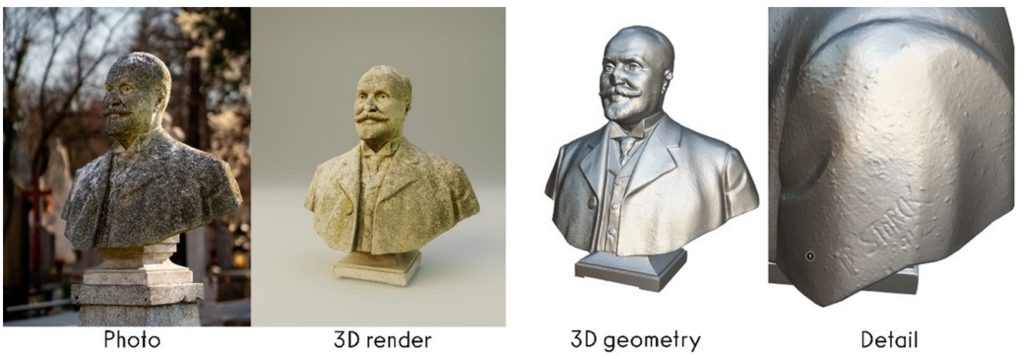

Fig. 7. Ion Danabassi by Frederic Storck (1912)

Little is known about Ion Danabassi and his family. From the documents of the time, we learn that in 1868, Ion Danabassi was the farmer who brought cotton to Romania for the first time. He brought seeds from Macedonia and cultivated them on the Manasia estate near Urziceni. Other farmers have borrowed the seed and planted it in Ilfov and Dobrogea.

Carol Storck – two busts for Petre Hr. Tarpo: man and woman (1923)

The busts are in the same condition as in 1958 when they were first documented by Bezviconi: fallen together with their pedestal and half buried in earth and vegetation. Both busts feature the same signature on their back: “C. Storck, sculpt. 1923”. Each bust was digitized separately, in December 2023, as follows.

The man’s bust is made of white marble and is sized 56×48×30cm. It was digitized from 585 images, generating a high-poly mesh model of 34 million polygons. It is signed on its back “C. Storck, 1923” (Fig 8). It is published online [48] at 10.000 polygons with color and normal map textures at 8192×8192 pixels.

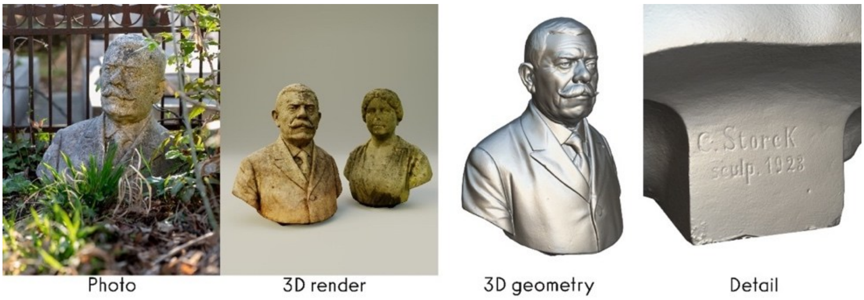

Fig. 8. Tarpo family bust - man by Carol Storck (1923)

The woman's bust is made of white marble and is sized 55×45×31cm. It was digitized from 570 images, generating a high-poly mesh model of 38 million polygons. It is published online [49] at 10,000 polygons with color and normal map textures at 8192×8192 pixels (Fig. 9).

Fig. 9. Tarpo family bust—woman by Carol Storck (1923)

Carol Storck – Areti N. Ghenovici (d. 1888)

The bust of a little girl that little is known about. Made of white marble and sized 70×37×23cm. It is in a poorer condition than in 1958 but still on its pedestal. The bust is signed "C. Storck fiul 1888" (transl. C. Storck the son 1888). The signature is not visible in the 3D scan surface, only with color texture (Fig. 10). The bust was digitized in December 2023 from 478 images, generating a high-poly mesh model of 18 million polygons. It is published online [50] at 10,000 polygons with color and normal map textures at 8192×8192 pixels.

Fig. 10. Areti N. Ghenovici by Carol Storck (1888)

Carol Storck – August Treboniu Laurian (1810-1881)

Made of white marble and sized 78×53×36cm. Signed and dated on the back "Storck. jun. 1886" (Fig. 11). The bust was digitized in September 2023 from 611 images, generating a high-poly mesh model of 27 million polygons. It is published online [51] at 5,000 polygons with color and normal map textures at 8192×8192 pixels.

Fig. 11. Augustin Laurian Treboniu by Carol Storck (1886)

August Treboniu Laurian (1810-1881), whose real name was Augustin Trifan, was one of the leaders of the 1848 Revolution in Transylvania He was also a founding father of the Romanian Academy (1867), and he started the first Romanian historical magazine together with Nicolae Bălcescu (1845).

Carol Storck – Lilica Marcela A. Stoicovici (1898-1907)

Made of white marble and sizes 64×36×24cm. Signed and dated on the back "Carol Storck 1909" (Fig. 12). The bust was digitized in February 2024 from 614 images, generating a high-poly mesh model of 33 million polygons. It is published online [52] at 10,000 polygons with color and normal map textures at 8192×8192 pixels.

Fig. 12. Lilica Stoicovici by Carol Storck (1909)

On the bust pedestal there is also a photograph of the girl buried here. The resemblance of the photo to the bust is staggering. Another interesting detail is that this bust was declared missing back in a 1995 study [53].

Carol Storck – Ioan I. Șerbănescu (1860-1906)

Made of white marble and sized 80×55×34cm. Signed and dated on the back "Carol Storck 1910" (Fig. 13).

Fig. 13. Ioan I. Șerbănescu by Carol Storck (1910)

The bust was digitized in September 2023 from 677 images, generating a high-poly mesh model of 22 million polygons. It is published online [54] at 5,000 polygons with color and normal map textures at 8192×8192 pixels.

Carol Storck – Russe Russescu (1845-1901)

Made of white marble and sized 78×56×32cm. Signed and dated on the back "Carol Storck 1910" (Fig. 14). The bust was digitized in September 2023 from 622 images, generating a high-poly mesh model of 24 million polygons. It is published online [55] at 5,000 polygons with color and normal map textures at 8192×8192 pixels.

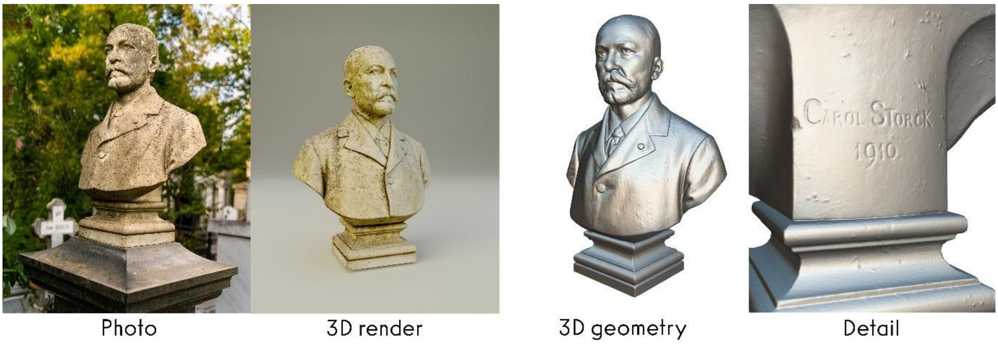

Fig. 14. Russe Russescu by Carol Storck (1910)

Carol Storck – Radu Negulici (1871-1904)

Made of white marble and sized 75×50×36cm. Signed and dated "Carol Storck 1905" (Fig. 15). On the detail image below there are markings from what was left of the climbing plants that were cleaned from the statue. The bust was digitized in July 2023 from 792 images, generating a high-poly mesh model of 58 million polygons. It is published online [56] at 5,000 polygons with color and normal map textures at 8192×8192 pixels.

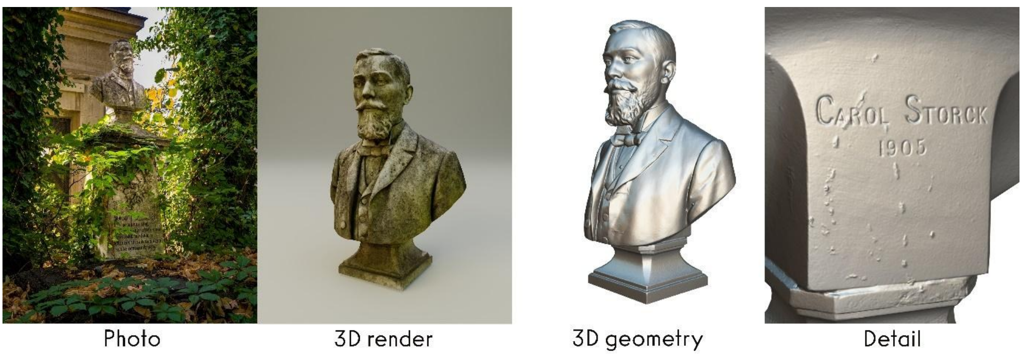

Fig. 15. Radu Negulici by Carol Storck (1905)

Carol Storck – Iulia Mulțescu (1875-1902)

Made of white marble and sized 77×46×30cm. Signed and dated on the back "Carol Storck 1907" (Fig. 16). The bust was digitized in February 2024 from 713 images, generating a high-poly mesh model of 37 million polygons. It is published online [57] at 10,000 polygons with color and normal map textures at 8192×8192 pixels.

Iulia Mulțescu (1875-1902) was a teacher at a boys' school in Curtea de Argeș, Romania.

Fig. 16. Iulia Mulțescu by Carol Storck (1907)

Conclusions

The focal point of this paper lies in raising a silent alarm concerning the overlooked nature of this particular type of cultural heritage. Artworks that transcend the initial role of funerary art into profound reflections of societal values, artistic mastery, and historical narratives deserve greater attention and protection, just like any other type of cultural heritage.

Understanding the implications and realities of dark tourism can turn it into a real means of protection. The great interest for both the spectacular artworks and the lost stories behind the names engraved on the tombstones can serve as catalysts for increased awareness, appreciation, and preservation efforts for these invaluable cultural treasures. In the first section of this paper, the notions of dark tourism and virtual dark tourism are introduced in relation to the phenomenon surrounding the most important cemetery in Romania and one of the few in the world that hosts such a great number of personalities and funerary artworks.

The importance of digitalization processes is also detailed to highlight the advantages for both the administration side and the dark tourism enthusiasts. Online databases and platforms are already implemented in many cemeteries, providing valuable information about the history of the people and the places they have inhabited. It is a unique direct link to the past unlike any other written or unwritten archaeological evidence. The efforts in documenting the Bellu cemetery showed the difficulty of finding lost information about seemingly important people and families.

The great interest shown on online platforms, such as Facebook and Instagram, has sparked an increased awareness of the critical condition of many of the cemetery's artworks. This heightened visibility has encouraged numerous enthusiasts to actively contribute their own findings about the forgotten personalities interred within. This collective effort not only sheds light on the historical significance of these individuals but also fosters a sense of community engagement and stewardship towards preserving this cultural heritage. In essence, it exemplifies a form of citizen science where individuals from diverse backgrounds come together to document, research, and advocate for the protection of these valuable artifacts and narratives.

To illustrate this approach, a case study was included, focusing on several funerary busts and sculptures crafted by members of the renowned artist family, Storck. The paper provides a brief description of the three sculptors: Karl Storck and his two sons, Carol and Frederic. Additionally, it emphasizes that while all significant Romanian artists, including those from abroad, have made notable contributions to the cemetery's heritage, the Storcks stand out with their impressive legacy therein. The selected artworks are part of the 3D digitization project started in Bellu Cemetery in the second half of last year (2023) and consist of two sculptures attributed to (but not signed by) Karl Storck, one bust signed by Frederic Storck, and other busts made by Carol Storck.

The purpose of the presentation of these artworks was to emphasize the added value the 3D digitization has to the virtual side of the dark tourism. The possibility to interact and explore 3D models with very high details (like artist signatures or antique clothing details) is one of the greatest assets of the whole digitalization process. To this it should be mentioned the standard role of digital preservation of the shapes and aspects of the artworks. Although it must be reiterated that the digital models of real artworks cannot replace them once they are destroyed or lost. 3D digitization does not count for protection measures; they should still be enforced even after this process.

Overall, the digital transformation of the promotion of the dark tourism and the volunteers' efforts in cleaning and researching the stories behind the beautiful funerary artworks have sparked great interest and support within the community. Each year more and more events and guided tours (organized by the Administration or other enthusiasts) are happening, with hundreds of participants. The open access to the interactive 3D detailed replicas allows them to safely study and explore the artworks, making them even more interested or engaging them in personal research to contribute to the public knowledge.

Both the documentation research and the 3D digitization process are still ongoing.

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