

Editorial

Special Issue on 3D Information Technologies for Tangible and Intangible Cultural Heritage—Motivations, Overview of Published Works, and Perspectives for the Future

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1. Motivation

The concept of tangible cultural heritage has been defined a long time ago and international legal acts have been created to protect, preserve, and popularize it. The most significant act is the “Convention Concerning the Protection of the World Cultural and Natural Heritage” adopted by the United Nations Educational, Scientific and Cultural Organization (UNESCO) in 1972 [1]. This convention obliges the members of the United Nations that have ratified it to protect their cultural and natural heritage. Material heritage is understood as a physical element of the heritage of humanity [1], and includes archaeological sites, historical monuments, artifacts, and other objects, as well as natural elements, such as physical and biological formations, geological and physiographical formations/areas, and natural sites/areas with high value for science, conservation, or natural beauty.

The intangible heritage of humanity was noticed much later. It was only on October 10, 2003 that the “Convention for the Safeguarding of the Intangible Cultural Heritage” was adopted by UNESCO [2]. Intangible cultural heritage is understood as, among others, “oral traditions, performing arts, social practices, rituals, festive events, knowledge and practices concerning nature and the universe or the knowledge and skills to produce traditional crafts” [3]. Intangible heritage understood in this way is inherited from our ancestors and should be passed on to our descendants as achievements of humanity. Intangible heritage is quite fragile because it mostly functions in human memory and if not “cultivated”, it disappears, i.e., is forgotten. At the same time, it is a testimony to cultural diversity that should be maintained in the face of growing globalization and unification.

Older technologies, such as analogue photography, sound, and video recording, are now being replaced by digital ones. Information Technologies (ITs) bring a new quality to these activities. However, [4] points to the relatively low dissemination of IT applications in the area of the intangible heritage of humanity.

IT has been and can be used in various ways in the broadly understood field of cultural heritage. This use may include, but is not limited to, the following areas: documentation, protection, reconstruction, restoration, conservation, dissemination, and popularization.

Documenting is primarily the registration of the condition of an existing tangible artifact or of elements of intangible heritage. For this purpose, various IT tech can be used: examples include digital photogrammetry, 2D and 3D scanning using different technologies, and digital recordings of voice, image, and character movement [5–9].

Protection primarily entails the use of IT in the areas of physical protection of objects of tangible cultural heritage. For this purpose, all types of supervision and access protection systems are used [10,11].

Reconstruction is supporting the physical reconstruction of lost elements (e.g., vessels, paintings, or buildings) or conducting this kind of reconstruction in the digital realm (e.g., creating digital twins of currently non-existent cultural heritage artifacts) [12–14].



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ITs can be used to support restoration and conservation works through spectral or statistical analysis of colours, materials, or technologies and through computer-aided planning of restoration/conservation activities [15,16].

Dissemination is the provision of information about cultural heritage to various social groups (e.g., scientists, guides, tourists). Modern ITs significantly reduce its costs and expand the range of recipients. They also increase the variety of data provided [17–19].

Popularization means providing a wide public with information about elements of cultural heritage. The IT tool used here is the Internet, thanks to various portals promoting cultural heritage [20,21].

In addition, the IT applications in the areas detailed above overlap with their uses in the field of scientific research, which concerns all areas: documentation, protection, reconstruction, restoration, conservation, dissemination, and popularization [22–24].

2. An Overview of Published Works

The following articles were published in the Special Issue titled “3D Information Technologies for Tangible and Intangible Cultural Heritage” (https://www.mdpi.com/journal/applsci/special_issues/information_technologies_cultural_heritage (accessed on 29 May 2024)):

- A. Kęsik, J.; Miłosz, M.; Montusiewicz, J.; Israilova, N. Documenting Archaeological Petroglyph Sites with the Use of 3D Terrestrial Laser Scanners—A Case Study of Petroglyphs in Kyrgyzstan. *Appl. Sci.* **2022**, *12*, 10521. <https://doi.org/10.3390/app122010521>;
- B. Montusiewicz, J.; Barszcz, M.; Korga, S. Preparation of 3D Models of Cultural Heritage Objects to Be Recognised by Touch by the Blind—Case Studies. *Appl. Sci.* **2022**, *12*, 11910. <https://doi.org/10.3390/app122311910>;
- C. Kaplan, K. Real-Time Rendering Engines Help Visualize, Model, and Animate Ancient Cities: An Example in Antioch. *Appl. Sci.* **2022**, *12*, 12316. <https://doi.org/10.3390/app122312316>;
- D. Kęsik, J.; Żyła, K.; Montusiewicz, J.; Miłosz, M.; Neamtu, C.; Juszczyk, M. A Methodical Approach to 3D Scanning of Heritage Objects Being under Continuous Display. *Appl. Sci.* **2023**, *13*, 441. <https://doi.org/10.3390/app13010441>;
- E. Cruz Franco, P.; Rueda Márquez de la Plata, A.; Pérez Sendín, M. Investigating a Workflow for Obtaining Physical Models from Digital Twins Obtained through Photogrammetry and TLS: New Ways for a Sustainable Dissemination of Heritage. *Appl. Sci.* **2023**, *13*, 1057. <https://doi.org/10.3390/app13021057>;
- F. Cao, M.; Jiang, H.; Zhao, H. Hash Indexing-Based Image Matching for 3D Reconstruction. *Appl. Sci.* **2023**, *13*, 4518. <https://doi.org/10.3390/app13074518>;
- G. Way, D.; Wei, Y. Use of Cloud-Based Virtual Reality in Chinese Glove Puppetry to Preserve Intangible Cultural Heritage. *Appl. Sci.* **2023**, *13*, 5699. <https://doi.org/10.3390/app13095699>;
- H. Kim, S.; Park, Y. 3D Reconstruction of Celadon from a 2D Image: Application to Path Tracing and VR. *Appl. Sci.* **2023**, *13*, 6848. <https://doi.org/10.3390/app13116848>;
- I. Korga, S.; Dzedzic, K.; Skulimowski, S.; Gnapowski, S. Optimising Amber Processing Using 3D Scanning: New Perspectives in Cultural Heritage. *Appl. Sci.* **2023**, *13*, 12973. <https://doi.org/10.3390/app132412973>;
- J. Diara, F.; Barsacchi, F.; de Martino, S. Moving beyond the Content: 3D Scanning and Post-Processing Analysis of the Cuneiform Tablets of the Turin Collection. *Appl. Sci.* **2024**, *14*, 4492. <https://doi.org/10.3390/app14114492>.

Among the published articles, only two out of ten (20%) discuss intangible cultural heritage, namely Chinese glove puppetry (article G) and the amber processing process (article I). Three articles (A, D, and J) focus on the documentation of objects of tangible cultural heritage, primarily using three-dimensional methods: terrestrial laser scanning and photogrammetry. Two articles are related to the reconstruction (articles F and H) of cultural

heritage objects and two to their popularization (articles B and C). One article presents the use of IT for the dissemination of heritage, while making it accessible to visually impaired.

3. Conclusions and the Future

Among the articles included in this Special Issue regarding the use of 3D IT in the area of tangible cultural heritage, the crucial fields of protection, restoration, and conservation are notably under-represented. The current situation, with conflicts increasing all over the world, encourages us to undertake research in these areas. Analysing the trends among the most recent publications in the area of cultural heritage, we can hope that this gap will effectively be reduced in the coming years.

The gaps in the area of intangible heritage are even greater. In this Special Issue, there are no articles on uses of 3D IT in areas such as oral traditions and talks (including story-telling), performing arts (such as dancing, singing, celebrations, games, and plays), rituals, crafts, etc. These areas require advanced research and application work. Similarly to the case of tangible heritage outlined above, articles covering this area are starting to be present in the heritage science space, which suggests an increase in interest in these areas in the coming years, which we are looking forward to.

Regardless of fluctuations in the scientific community's areas of interest, new methods and 3D IT devices are being created or improved, including the following:

- mobile, air and UAV lidars;
- satellite imaging;
- geo-radars;
- motion capture systems.

Additionally, work is underway to improve the software for processing 3D data and spatial modelling obtained using the above methods. Meanwhile, artificial intelligence is entering various areas of science and technology, including everyday life, and will inevitably also reach the scope of heritage science.

This Special Issue of the journal *Applied Sciences* has been closed. However, the continuous development of research on and applications of 3D IT in the area of cultural heritage results in interesting new publications. The editors of *Applied Sciences* appreciate this branch of science and have decided to continue this scientific journey in an upcoming Special Issue titled "Challenges and Current Applications of 3D Information Technologies for Cultural Heritage" (https://www.mdpi.com/journal/applsci/special_issues/726R29M8E4 (accessed on 29 May 2024)).

We are pleased to invite all potential authors to consider it in their current or future academic endeavours.

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