

The D-TECH project

Digital Twin Environment for Cultural Heritage

Marco Canciani, ROMA TRE University, Department of Architecture Italy

Giovanna Spadafora, ROMA TRE University, Department of Architecture, Italy

Mauro Saccone, ROMA TRE University, Department of Architecture, Italy

Carla Masetti, ROMA TRE University, Department of Humanities, Italy

Arturo Gallia, ROMA TRE University, Department of Humanities, Italy

Marialuisa Mongelli, ICT Division, Department of Energy Technologies and Renewable Sources, ENEA, Italy

Beatrice Calosso, ICT Division, Department of Energy Technologies and Renewable Sources, ENEA, Italy

Marco Puccini, ICT Division, Department of Energy Technologies and Renewable Sources, ENEA, Italy

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Abstract The digitization of cultural heritage (CH), also accelerated by the Covid pandemic, is directed not only at the cultural institutions that protect the heritage, but also at those who study it, keep it alive with research, who enhance it, reinterpret and rethink it according to according to FAIR (findable, accessible, interoperable and reusable) and LOD (Linked Open Data) principles, new communication language and new technologies. Digital copies (Digital-Twin) of CH involve all aspects of an asset's life, from 3D surveys for documentation to virtual and Augmented Reality initiatives for its enhancement.

The D-TECH (Digital-Twin Environment for Cultural Heritage) project currently in progress, financed by Lazio region and MIUR, aims to create an advanced multimedia platform dedicated to cultural heritage managers, which will offer web services for sharing and visualizing digital copies of movable and immovable cultural heritage assets. The platform responds to the need to preserve the historical memory of the cultural asset, through the creation of the digital twin ensuring the survival of the asset even where it should, be damaged by events of different nature, or no longer be accessible, should an event such as the recent pandemic prevent it from being physically visible.

The project fits into this sphere and intends to develop an innovative product, ready to be released on the market, usable for a very wide range of applications and/or application contexts capable of opening multiple business opportunities for companies in the sector.

It is, in fact, a platform for the management of the production cycle of cultural content dedicated to the entire "value chain" (knowledge, diagnostics, conservation, restoration, enhancement, enjoyment and management), which will allow, especially the online publication, the online publication of 3D models, HBIM, point clouds and GIS and will offer tools for the monitoring, planning, enjoyment and enhancement of CH from its digital copies (Canciani et al., 2020, pp. 18–23).

The project aims to realize a product with high technological maturity, a web-based platform that will have a very strong incentive for the digitization of the CH and progress in the ICT sector.

The platform has a modular structure consisting of dockerized components linked together, through software that allows data to be able to dialogue, according with the FAIR and LOD principles and a semantic structure that to establish relationships with other databases, such as Arco (Architecture

of Knowledge) (Carriero, V.A. et al., 2019). More specifically, in order to overcome the problem to link together data acquired and/or produced by different technologies and institutions which work in the field of digitalization of CH assets and also to overtake the difficulty about data ownership, the project offers a space where data can be shared, thanks to an Ontology that allows also the creation of links between them, but their management remain in the exclusive availability of the owner, who can choose, based on differentiated user levels (viewer, user, super-user), how, what and how much to share

Together with the platform, the basic component of which is completely Open Source, the company and consortium partners will offer advanced services according to pay-per-use logic, such as: digitization and archiving; tools for advanced analysis of 3D models; and mobile applications for the realization of customized Virtual and Augmented Reality projects (Fig. 1).

The access to the platform, which is guaranteed to all cultural property managers/owners, constitutes a real standardization of the management process of the entire life cycle of the cultural assets.

The web-based platform does not require users to install software and offers client-side tools capable of handling different formats of 3D models and ensures that multiple data formats and GIS content can be associated with them (Fig.2).

Managers will therefore be able to manipulate 3D data and models to support both the conservation phase of the asset, taking advantage of some tools to measure, monitor and plan diagnostic interventions, and the enhancement phase using tools for publishing 3D models online and mobile applications for the realization of Augmented and Virtual Reality projects (Mongelli et al., 2018, pp. 324–347).

Working with the tools offered by the platform makes it possible to take advantage of a system that is organized in such a way as to guarantee the same workflow for all and thus to be able to plan restoration and conservation interventions by an integrated approach and use tools for eventual enhancements.

The project involves the development of a product which consists of a free-use "Kore" module that can be downloaded, installed, and used for free, and a series of service packages and tools that can be sold/borrowed to the museum that may be interested in using these advanced features, according to a business model defined as "freemium." Thus, it is planned to implement a free-use tool and a dedicated proprietary app (e.g., D-TECH-APP) that will allow, starting from the 3D object uploaded to the web platform, an Augmented Reality visualization, enabled by framing a printed logo, with the device. The logo could, for example, depict a representative element of the museum, exhibition or collection. Different modes of association, such as those that do not use the marker or take advantage of automatic geographic positioning, are to be considered in the advanced version or as an additional service, by taking advantage of various experiences in the field of VR and AR of CH (Canciani, et Al. 2018, pp 237–250), (Canciani, Spadafora, Saccone, Camassa, 2021, pp.241–245).

Nevertheless, the issue of copyright and data ownership are guaranteed in accordance with the Italian National Plan for Digitization (NPD) of cultural heritage 2022-2023.

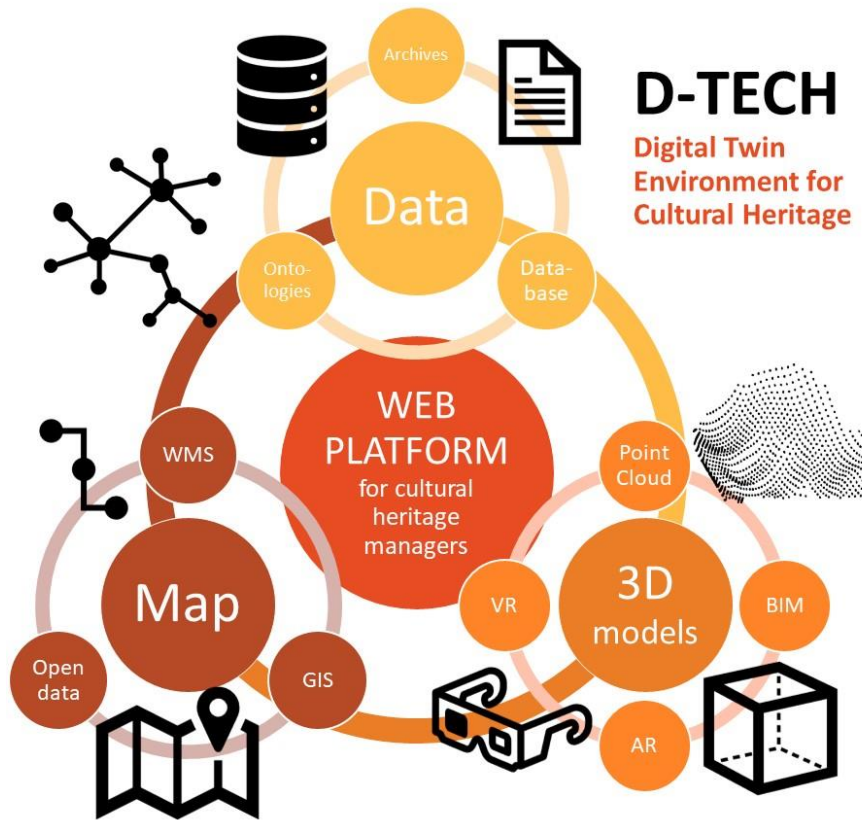


Fig. 1. D-Tech web platform ideogram

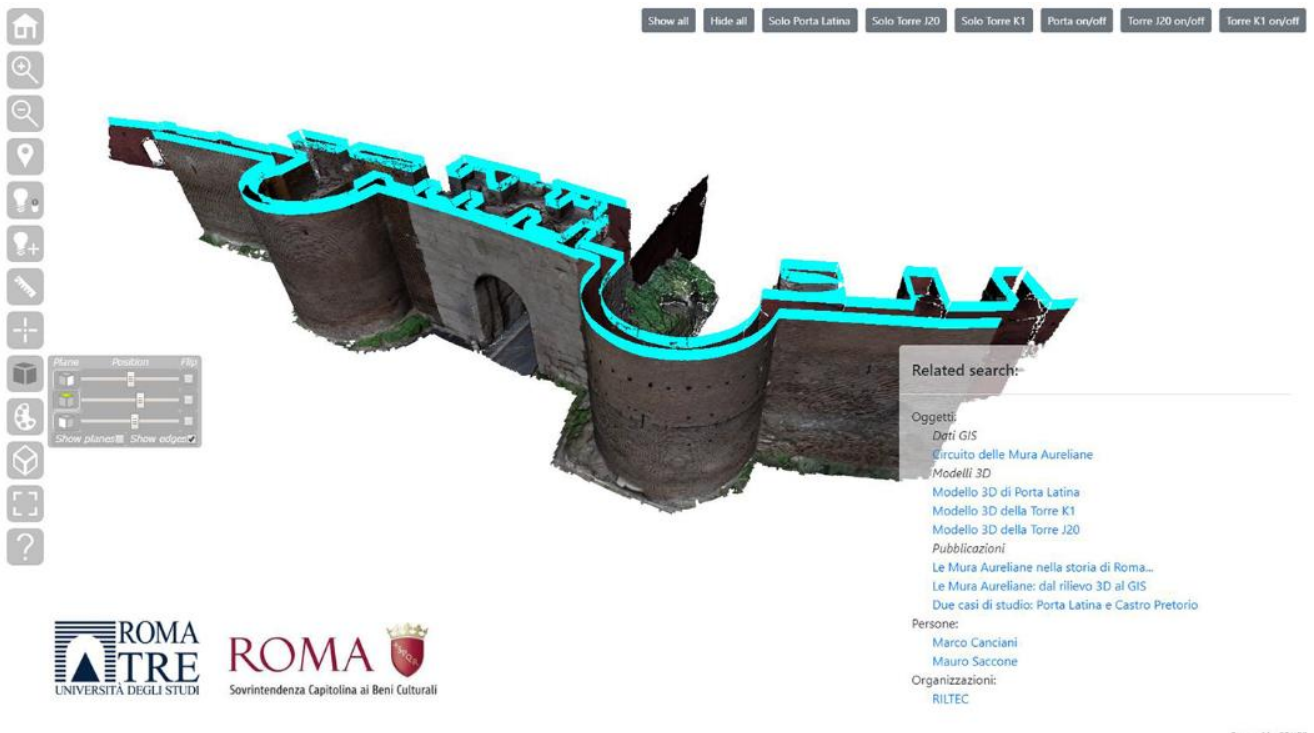


Fig 2 Porta Latina to the Aurelian Walls - User friendly interface and tools in development

References

- Canciani, M., Saccone, M., Spadafora, G., Migliori, S., Mongelli, M., Puccini, M., Quintiliani, A., Gallia, A., Masetti, C., (2020). Modelli 3D e dati GIS: una loro integrazione per lo studio e la valorizzazione dei beni culturali “ in *Archeomatica*, June 2020, pp. 18-23. <https://www.mediageo.it/ojs/index.php/archeomatica/article/view/1749>
- Carriero, V.A. et al. (2019). ArCo: The Italian Cultural Heritage Knowledge Graph. In: et al. *The Semantic Web – ISWC 2019*. ISWC 2019. Lecture Notes in Computer Science, vol 11779. Springer, Cham. https://doi.org/10.1007/978-3-030-30796-7_3
- Mongelli, M., Bellagamba, I., Iannone, F., Bracco, G., (2018). “From 2D digital imaging to finite element analysis using the ENEAGRID high performance computing infrastructure for the preservation of historical masonry structures” in *International Journal of Masonry research and Innovation*, July 2018 pp324-347 <https://www.inderscience-online.com/doi/abs/10.1504/IJMRI.2018.093492>
- Canciani, M., Pastor Altaba, M., Saccone, M., Falcolini, C. (2018). *Ricostruzione virtuale e realtà aumentata: il caso di studio dell'Arco di Tito al Circo Massimo*. In *BULLETTINO DELLA COMMISSIONE ARCHEOLOGICA COMUNALE DI ROMA*, p. 237-250.
- Canciani, M., Saccone, M., Spadafora, G., Camassa A. (2021). Augmented Reality as a Research Tool, for the Knowledge and Enhancement of Cultural Heritage. In (a cura di) Andrea Giordano, Michele Russo, Roberta Spallone, *Representation Challenges: Augmented Reality and Artificial Intelligence in Cultural Heritage and Innovative design Domain (REACH)*, FRANCO ANGELI, pp 241–245).
<https://series.francoangeli.it/index.php/oa/catalog/view/686/537/4023>