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Enlivening the Heritage Digital Twin

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The term "digital twin"has been used to designate 3D models of physical cultural artefacts to which additional information might be added. If the 3D model consisted in a point cloud, as in the case of generating it via scanning, such information was attached to its points or regions as a sort of Post-it, thus creating so-called "augmented objects". When, instead, CAD systems are used to produce the 3D model, the extra data were incorporated in an extension of BIM (Building Information Modelling) called HBIM (Heritage BIM), which adds the heritage-related necessary classes to BIM, an ISO standard used in the construction industry to incorporate information about materials, services and processes of a building.
In 2023 we proposed a novel ontology for heritage information based on the Heritage Digital Twin (HDT) a holistic approach to heritage information where the 3D graphical component is just one element. It allows to document intangible heritage as well, where the visual documentation may consist in video or audio recordings or even be totally absent. Such ontology, named HDTO, is a compatible extension of CIDOC-CRM, the standard for heritage documentation, allowing a straightforward incorporation of existing data organized according to it. The HDTO has been used to set up the cloud-based Knowledge Base (KB) created in 4CH, an EU-funded project designing a Competence Centre for the Conservation of Cultural Heritage. Documentation in the 4CH KB includes the relevant information about heritage assets, from visual one to the results of scientific analyses, conservation activities and historical documents.
The HDT does not consider the dynamic and interactive aspects connecting a digital twin to reality. The proposed improved model, named Reactive HDT Ontology (RHDTO), includes the documentation of dynamic interactions with the real world. A first example of application concerns the Internet of Cultural Things (IoCT), i.e. the use of IoT in the cultural heritage domain, for example fire sensors based on smoke or heat and other environmental sensors, activating processes and reactions. But the connection with reality may also consist in data directly provided by external digital systems, such as those providing weather forecasts or monitoring landslide hazards. The "reactive"nature of the system consists in three steps: an *input/sensor*, receiving data from the real world and processing them; the resulting outcome is input into a *decider*, which then transmits orders to an *activator*: each of them is documented as a member of a digital process RHDTO class and the related process is described in a specific instance of it. Such instances vary according to the nature of the planned reaction and are programmed according to scientific or heuristic knowledge about the relevant phenomenon, which may also be stored in the KB. The system may be connected and receive inputs from larger models such as the Digital Twin of the Earth, the ECMWF or the CMCC. Finally, the system allows also "what-if"simulation to experiment risks and mitigating measures, by defining simulated deciders and activators and providing as outcomes the simulation results.

Topic

Needs and solutions in scientific computing: Digital Twins

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