Defining a Metaverse for the Cultural Heritage

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Keywords: *Metaverse — Cultural Heritage — Digital Twin — NFT — modelling*

CHNT Reference: Cantaluppi, E., Ceccon, L. (2022). 'Defining a Metaverse for the Cultural Heritage', in CHNT Editorial board. *Proceedings of the 27th International Conference on Cultural Heritage and New Technologies, November 2022.* Heidelberg: Propylaeum.
DOI: xxxxxxx.

What is the Metaverse?

The notion of Metaverse is somewhat unclear, as it seems to encompass several converging digital technologies – including Augmented Reality (AR), Virtual Reality (VR) and Mixed Reality (MR) – without focusing on any in particular. In this paper, while acknowledging that the definition of Metaverse is uncertain, some speculation is carried forward relating to the features the Metaverse should offer in order to be something really novel and useful for the Cultural Heritage. Three main features characterizing the possible definition of metaverse have been identified in: the existence of a virtual layer over a real one, intertwined together; the shared experience of said environment among users who may be physically distant, yet visible to each other through avatars; the interactive nature of the experience, which can allow for a cyber-physical action to be carried forward jointly by various users. As to the underlying enabling technologies, a selection of the most relevant ones shall be then performed based on the specific features deemed particularly useful for CH, as follows.

Disruptive opportunities for CH

Interaction from anywhere.

Being Metaverse mainly related to the entertainment and retail world, the existing platforms offer little to none interaction with the real physical world and don't relate to any real-world item or place, while avatars are the only connection between the real and the virtual. Avatars are the way players access the Metaverse, but usually they are not particularly suited to represent and express body gestures and positions which could be exploited for more serious purposes, e.g. by archaeologists operating on a real excavation site.

Mixed Reality and real-time interaction with Digital Twins.

Even though realism is not necessarily needed to make the Metaverse useful for professionals or even for dissemination aims in the field of Cultural Heritage, some aspects of realism and precision would allow for a clearer link between the cyber and the physical, thus reciprocally enriching one another. A shared Digital Twin would ensure a biunivocal link between virtual and real CH items,

and people would be able to perform on the items while cooperating with each other, including remote users. At its extreme, the cyber-physical paradigm may even encompass actuators which would make it possible for the actions performed by the users in the virtual realm to become real. The sharing of different dimensions of reality would enable archaeologists to even "physically" work together, sharing real-time impressions, but also real-time gestures.

a b

Fig. 1. Mixed Reality simulation on a brutalist Cultural Heritage building: the Fologram app on HoloLens 2, iOS and Android. a) users with smartphones and AR headsets interact with a b) 3D model and a point cloud in Rhino.

The plurality of Metaverses

Scholars have sometimes used the plural word Metaverses in order to underline that there is not a unique entity, rather several virtual worlds not connected to each other even within a single platform. However, as already shown by the existence of a plurality of possible geometries within H-BIM models according to different Level Of Detail, the plurality of Metaverse platforms may just enrich the available options in terms of customized experience and contents. For instance, we could imagine the co-existence of several Metaverses (or, at least, several metaverse platforms), each targeting different audiences and serving different aims – from the mere recreational purposes to the joint academic research in CH – where virtual technologies could let users experience the cultural heritage, sharing data and interacting with different sources, the same way different social platforms do. Mixed realities technologies enhance the user engagement, letting them experience cultural heritage through an integrated narrative that could involve several media. Based on the foregoing main features and observations, some extra promising add-on features are analysed in view of applying the concept of Metaverse, as outlined, to CH projects.

NFTs for the protection of Cultural Heritage.

While the plurality of Metaverse platforms may be deemed to bring the benefits of competition to the field, leading to the refinement of targeted tools for different audiences, the lack of a unique reference linked to a real CH item or site may limit the effectiveness of the tool itself in view of protecting it. In fact, both as an experience, and (consequently) as a possible financing instrument, the lack of uniqueness may result in a lack of specificity, hence commitment offered to users and fundraisers. Hence, the paper will show how blockchain-based Non-Fungible Tokens can add to the

CH Metaverse such flair of uniqueness, yet maintain the useful plurality of positions, user types and modelling efforts. The NFT technology provides an effective way to make a model of a real object (e.g. a Digital Twin), or at least a tag related to the real object, as unique as the real object itself. NFTs can ensure that any contingent digital experience/environment is linked to a unique entity in the real world, certified as such, allowing for pluralism, yet, clarifying the real relationship between the creators and the real CH item, also from a legal standpoint.

Sharing the Cultural Heritage: standards for interoperability.

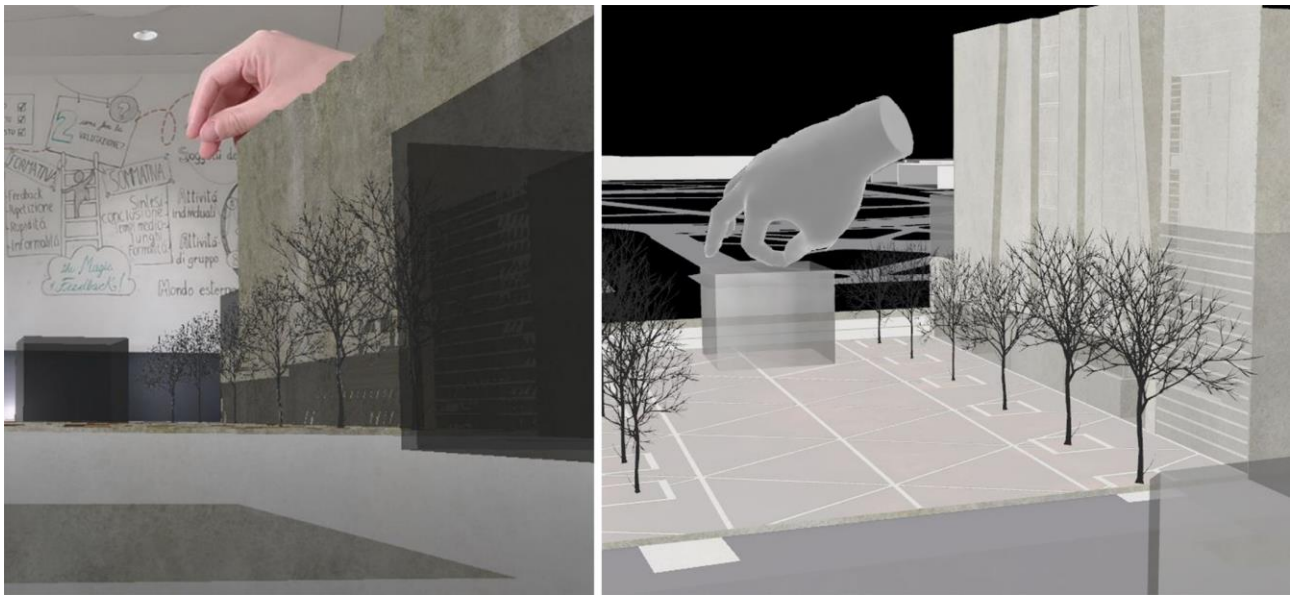
A very important aspect related to the sharing of CH knowledge in the Metaverse, especially hypothesizing the access to a same portion of metaverse from different platforms, lies in the data interoperability and information sharing. While not necessary as building block of the Metaverse perse, interoperability would greatly enhance the usefulness of CH shared experiences in the Metaverse, e.g. allowing scholars to “chorally” build, share and combine data and models about CH items also across multiple platforms. The use of taxonomies and semantic ontology frameworks in the Metaverse would be an extension of similar approaches currently adopted in the field of CH, such as the CIDOC Conceptual Reference Model framework. Given the plurality of possible portals and environments, it seems that some kind of portal specialization may develop in order to facilitate the use of such frameworks, with domain-specific taxonomies, tools and workflows, embedding the most established practices in the fruition of the Metaverse for that specific area of knowledge.

Access to modelling tools for Cultural Heritage in the Metaverse.

Finally, but not less importantly, the Metaverse will rely even more on the digital representation techniques. Models are possibly not only not a copy of the exterior appearance of the real world, rather a real-time, dynamic simulation tuned and synchronized to it, or to the knowledge about it. While the established modelling software packages will probably continue to constitute the main tools used in this field, the main challenge will consist in offering scholars, as well as the wider audience, some kind of accessible tools to co-produce models for the Metaverse. In this regard, the “no-code” or “low-code” paradigms seem a promising way to grant a wider access to the Metaverse in an active way, rather than as a mere consumer of prefabricated materials. A decentralized but shared access to contents, and content creation tools would then possibly help in accruing data and knowledge, while the ordered convergence of such data towards some kind of unique CH item, as described, would help in making that data semantically and hierarchically ordered, hence usable.

Conclusions

This paper aimed at defining the main features and potential of a Metaverse for CH. Given the still floating definition of the Metaverse itself, a main set of features linked to its various implementations have been identified, while a set of “nice to have” promising features and related technologies to make the Metaverse an even greater tool to share and protect the CH have also been suggested.



a *b*

Fig. 2. Fologram environment. a) changes - performed remotely through the HoloLens 2 headset - b) are experienced real-time in the 3D model simulation.

Conflict of Interests Disclosure

There are no financial or personal relationships with other individuals or organisations, such as sponsors, that could make this work biased or influenced.

Author Contributions

All work has been performed jointly by the two authors.

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