Chapter 5

Virtual Reality (VR), Augmented Reality (AR), and Historic Building Information Modeling (HBIM) for Built Heritage Enhancement: From Geometric Primitives to the Storytelling of a Complex Building

Fabrizio Banfi
Department of Architecture, Politecnico di Milano, Italy

Daniela Oreni
Politecnico di Milano, Italy

ABSTRACT

The latest developments in the field of generative modeling and building information modeling for heritage building (HBIM) have allowed the authors to increase the level of transmissibility of information through the most modern techniques of virtual and augmented reality (VR-AR). This chapter summarises the last years of applied research in the field of three-dimensional modeling oriented to digitise and correctly represent the built heritage thanks to the integration of the most modern three-dimensional survey techniques with a scan-to-BIM process based on new grades of generation (GOG) and accuracy (GOA). The new paradigm of the complexity of the built heritage, its tangible and intangible values, have been shared through new immersive ways able to increase the information contents and the knowledge accumulated in the last years of one of the most representative and unique buildings of the Lombard architecture: the Cà Granda in Milan.

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INDUSTRY 4.0 METHODOLOGIES FOR BUILT HERITAGE DOCUMENTATION, STORYTELLING, ENHANCEMENT AND CONSERVATION ACTIVITIES

“The expression Industry 4.0 conveys a vision of the future in which digital technologies help industrial and manufacturing companies to increase their competitiveness and efficiency through interconnection and cooperation between their own resources (plant, people, information), both within the factory and all along the value chain. Digital technologies are at the heart of Industry 4.0”, also applied to Cultural Heritage: among them, BIM modeling, augmented reality and virtual reality are particularly relevant methodologies.

In particular, the three-dimensional modeling of historical buildings, together with virtual reality and augmented reality, have opened a few years ago the possibility of creating innovative ways of documenting, enhancing, telling the story of the built heritage and managing conservation activities. This digital form of representation lay their foundations in the integration of accurate geometric survey data with other kinds of information (historical, material, stratigraphic, etc.), allowing to create models potentially more sophisticated and rich in content (Oreni, 2013), but at the same time more and more user friendly and accessible with the use of devices with low cost and wide diffusion. This possibility permits, for example, combining the needs of culturally verified and deepened contents, typical of scientific research, with the educational ones, more related to tourist purposes, even for a public of non-experts. These needs seem more complex to combine the more the arguments regard specific technical aspects, and therefore, they are not easy to understand from a public of non-specialists. At the same time, it should not be forgotten that virtual 3D models can themselves become a research tool, allowing non-destructive operations of investigation and analysis of buildings, avoiding, for example, actions of material removal to detect parts below what is visible. Among innovative digital technologies, Historic Bim Modeling (HBIM) represent an interesting instrument to gather, manage and implement different information about built heritage within its components 3d representation: information about the geometry of the elements, about the materials, the state of conservation, the history, but also about an eventual conservation project and a precise economic evaluation of the different activities. Therefore, HBIM could be considered as an instrument of conservation activities management, allowing more agile data exchange between the different actors of the project and future implementation of the information (i.e. for maintenance activities). In this sense HBIM could be considered as an instrument of industry 4.0 applied to cultural heritage (reference: Italian Uni 11337/2017).

Moreover, the tools of virtual and augmented reality are a great resource for the enhancement of historical buildings and archaeology, allowing the documentation and the storytelling of what they are today and what is no longer visible or at risk of disappearance (i.e., the built heritage in areas of high environmental or anthropogenic risk) (Banfi, 2019) (Bolognesi, 2019).

The three-dimensional reconstruction of what is left can, in fact, be integrated in a virtual way with what has disappeared, giving a “complete” virtual image of the building, whose material reconstruction is obviously no longer contemplated, for recognized needs of authenticity and preservation of the historic heritage. These observations start from the recognition of the uniqueness but also of the fragility of the cultural heritage, for which we are responsible for the future. Furthermore, cultural heritage represents an important driving force for the sustainable development of communities, as an element of identity, based on the material authenticity of the heritage (The Paris Declaration on heritage as a driver of development, ICOMOS, Paris, 2011).
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