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Editorial

Editorial for the Special Issue: "3D Virtual Reconstruction for Cultural Heritage"

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The use of 3D modelling, computer-aided design (CAD), augmented reality (AR) and virtual reality (VR) for the acquisition and virtual reconstruction of Cultural Heritage is of great importance in the analysis, study, documentation and dissemination of the past. Reverse engineering (RE) and computer graphics (CG) are also relevant aids for the visualisation and preservation of Cultural Heritage. The integrated use of AR and VR technologies helps to accomplish the full potential of 3D models obtained with reality-based techniques and CAD data, and it aims at interactively communicating the significance of the heritage to non-experts. AR and VR are valid tools for interacting with 3D models and help make culture more accessible to the wider public. Their flexibility can help museum curators to adapt cultural proposals and information about artefacts based on different types of visitor's categories. These technologies allow visitors to travel through space and time, have fun and get educated on complicated topics. VR/AR technologies are also extremely useful for recreating a lost or hidden environment, leading to a better comprehension of the site or allowing people to discover important sites that are not visible, both for security and conservation reasons.

In this Special Issue, different uses of CAD reconstruction and virtual technologies have been considered. Nine papers have been published within this Special Issue [1–9]. The application of VR and AR are underlined and explained, considering different levels of details and applications. The importance of AR visualisation of brick details is explained in [1], where photogrammetry and smartphone AR are compared in order to verify a suitable methodology for documentation. The cross-referenced results are compared with a simplified reconstruction process to inspect parts of brick warehouses and comprehend their construction complexity. The possibility to build up a collaborative space that allows sharing the reconstruction data and methodology is explained in [2]. The process that led to the virtual reconstruction of buildings from plans is carefully and methodologically explained in order to make the pipeline reliable and reproducible. The authors of [3] present a system to enhance the realism of the experience in VR environments using physical copies coupled with real-time hand tracking systems that allow the user to change the virtual appearance of the virtual object. VR and AR can be a great help in making accessible areas characterised by a high degree of physical and chemical integrity risks. The authors of [4] present a methodology that allows tourists to visit wooden churches while considering the preservation and conservation of the Heritage. With the use of a web portal in which the 3D models are stored, coupled with panoramic images, audio support, photographs and texts, a rendered VR reproduction is displayed for virtual tourism, accompanying the raising awareness in the visitors regarding a delicate Heritage. The documentation and better understanding of an archaeological area are presented in [5], in which the authors, starting from excavation data and 2D information, developed a GIS and 3D reconstruction of a 4th–11th-century cemetery. The 3D models are coupled with geostatistical analyses and taphonomical and anthropological data to create a better understanding of the site both for researchers and the general public. Virtual reality can also be used for underwater heritage, which by its nature is almost impossible for tourists to reach. The Virtual

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Museum-Underwater Malta [6] was created for the specific purpose of displaying the important underwater archaeological sites of the isle of Malta. Three-dimensional models were obtained through underwater photogrammetry and used for the creation of a virtual underwater world that can be visited by everyone interested. Such applications are hugely important because they allow not only documenting and thus preserving hidden heritages, but also visitors can visit and become aware of the difficulties in conserving these areas. The use of digital and virtual technologies for the digital narrative and storytelling is investigated in [7] to scrutinise the role of digital technologies in facilitating digital placemaking. The process not only aims at capturing, simulating and disseminating lost heritage but also imbuing a sense of place and connection. The performance of feature extraction and feature matching as a basis for automatic 3D reconstruction are evaluated in [8]. After estimating seven different feature extraction methods on problematic surfaces of a 3D real and virtual planar surface and considering the most suitable pattern histogram, the best performing pattern is used to recreate a polygonal model of a 3D-printed object using the feature extraction methods and evaluate the standard deviation in order to identify the best solution. Finally, a new way to interact with a 3D high-quality reconstruction in a real-world scenario is investigated in [9]. The VR application developed for multi-modal purposes is designed for a multi-user digital immersive experience. The application is explained considering scene optimisation, locomotion system and the definition of the multi-user environment, and it was tested in a touristic context.

All the published papers highlight the increasing importance of virtual and augmented reality in the documentation and exploitation of Cultural Heritage and emphasise the different areas of application in the field of Cultural Heritage, underlining their cross-sectoral applications.

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