Editorial

Editorial for Special Issue "Virtual Reality and Its Application in Cultural Heritage"

Christos Fidas [1,*] **and Stella Sylaiou** [2]

1   Department of Electrical and Computer Engineering, University of Patras, 26504 Patras, Greece
2   Department of History and History, Aristotle University of Thessaloniki, 54124 Thessaloniki, Greece; sylaiou@gmail.com
*   Correspondence: fidas@upatras.gr

Contents of This Issue

Recent advancements in Virtual Reality (VR) technologies provide new opportunities for Cultural Heritage (CH) organizations to attract, engage, and support end-users more efficiently and effectively. Uses of such emerging technologies in CH can create unprecedented interactive experiences that scaffold users' learning, foster creativity, and collaboration, oftentimes through entertainment. However, several user studies have underpinned the necessity to further investigate and improve current approaches and practices related to the design, implementation, and evaluation of VR applications to meet and fulfill the needs and requirements of all involved stakeholders. One possible way to achieve this objective is through the provision of personalized VR user experiences that cater to the diverse characteristics and requirements of stakeholders.

The motivation behind this Special Issue is to attract leading researchers at the intersection of VR and cultural heritage and thereby highlight the latest exciting developments in this field, as well as provide an outline of the underlying methods and approaches for designing, implementing, and evaluating VR experiences in the cultural heritage domain. This special issue presents innovative approaches that provide insightful theoretical, methodological, and empirical contributions to this field as well as future research suggestions. These contributions include theoretical considerations, experimental validation, and proof-of-concept applications. This special issue emphasizes the state-of-the-art in the field presenting innovative uses of VR (as well as MR) in Cultural Heritage (CH), but moreover, critical examination of existing practices to further improve them in the future.

After a rigorous peer-review process, we selected seven (7) papers. Each paper received three reviews from independent experts. These papers cover a wide range of topics including a combination of Virtual Reality (VR), Mixed Reality (MR), and Augmented Reality (AR) applications within various use cases of cultural heritage contexts.

The first article titled "*Virtual Reality in Museums: Exploring the Experiences of Museum Professionals*" is examining the experiences of museum professionals who are responsible for a museum's objects and narratives [1]. Consequently, this paper aims to explore the practices, experiences, and perceptions of museum professionals on the use of VR technology in museums, their perceived advantages and challenges of such technologies, and their vision for the future of technology in museums. The paper provides an in-depth analysis of interviews with museum professionals from a number of countries around the world who worked with particular VR projects in their own institutions. The ultimate aim is to offer a more critical and holistic examination and assessment of the use of VR in museums and provide suggestions for designing and developing VR projects in the future.

The second article titled "*Mergin' Mode: Mixed Reality and Geoinformatics for Monument Demonstration*" presents a Mixed Reality (MR) project namely, "Mergin' Mode", presenting a specific application that accrued from it with emphasis on the authoring tool underpinning it [2]. "Mergin' Mode" project's initial application aims at demonstrating a specific

monument combining the present state with an overlaid reconstruction of its original structure, through the merging of the real with the virtual, and with the employment of geoinformatics technologies. The project aims at providing an open-source platform that relies on location-based data and services, exploiting geospatial functionalities. In the long term, it aspires to contribute to the development of open cultural data repositories and the incorporation of cultural data in location-based services and smart guides, to enable the web of open cultural data, thereby adding extra value to the existing cultural-tourism ecosystem. The stages of the innovative application's development are presented, from data acquisition through photogrammetry to the Virtual Geospatial World of the Monument and the final overlaying of a 3D model of the ancient building upon existing structures along with an overview of the functionalities it offers for its users.

The third article titled "*ArkaeVision VR Game: User Experience Research between Real and Virtual Paestum*", presents the ArkaeVision VR application which takes advantages of storytelling and user experience design to tell the story of artifacts and sites of an important cultural heritage site of Italy, Paestum, creating a dramaturgy around them and relying upon historical and artistic content revised by experts [3]. Visitors will virtually travel into the temple dedicated to Hera II of Paestum, in the first half of the fifth century BC, wearing an immersive viewer–HTC Vive (High Tech Computer Corporation, New Taipei City, Taiwan); here, they will interact with the priestess Ariadne, a digital actor, who will guide them on a virtual tour presenting the beliefs, the values and habits of an ancient population of the Magna Graecia city.

The fourth article titled "*Virtual Reality Models Based on Photogrammetric Surveys—A Case Study of the Iconostasis of the Serbian Orthodox Cathedral Church of Saint Nicholas in Sremski Karlovci (Serbia)*" presents a method for providing VR experience in the context of cultural heritage by developing a workflow for the VR applications based on photogrammetric models [4]. The proposed workflow was applied to the iconostasis of the Serbian Orthodox Cathedral church of Saint Nicholas in Sremski Karlovci (Serbia). The presented method is based on the following main steps: generation of an accurate 3D reconstruction of the iconostasis using photogrammetry, the 3D model optimization, retopology, control and analysis, and the process of creating the VR experience using a game-engine. The final result is an interactive walk through the church, which provides the user with an opportunity to visualize the iconostasis and its individual icons through different perspectives and multiple levels of detail, which is not otherwise possible when observing the church interior.

The fifth article titled "*Virtual Environments and Augmented Reality Applied to Heritage Education. An Evaluative Study*" presents a systematic study and assessment of the educational uses of Virtual and Augmented Reality (VR/AR), such as educational projects, programs, 'designs' and resources that relate to heritage education [5]. VR and AR can foster the accessibility and understanding of culture and propose new ways of interacting with heritage. However, the fulfillment of this potential depends on a number of factors identified in this survey. The systematic evaluation which this article presents is carried out on 197 heritage education programs listed in the database of the Observatorio de Educación patrimonial en España (OEPE) (the Spanish Heritage Education Observatory–SHEO) which, in their descriptions, integrate the use of virtual environments and/or augmented reality to promote learning on the part of the user. This study evaluates the quality of their educational designs and identifies variables that can be improved or which have a significant influence on the quality of the programs. Certain strengths as well as areas where there is space for improvement are identified and discussed, thereby highlighting issues that need further attention in the implementation of VR and AR in heritage education initiatives.

The sixth article titled "*Investigating the Learning Process of Folk Dances Using Mobile Augmented Reality*" presents a study of a prototype mobile Augmented Reality (AR) application for assisting the process of learning folk dances [6]. The presented application involves the digitization of a folk dance based on recordings from professional dancers. Moreover, avatar representations are synchronized with the digital representation of the dance. The effectiveness of mobile augmented reality in this context was assessed and comparatively

evaluated with a large back-projection system in laboratory conditions. The results indicate that AR had moderately better results compared to a standard projection screen, whereas a discussion on possible improvements and issues to be addressed is provided. The overall conclusion is that the use of AR as a complementary tool for supporting dance lessons is promising and may enhance learning in this area significantly in the future.

The seventh article titled "*A Digital Reconstruction of a Historical Building and Virtual Reintegration of Mural Paintings to Create an Interactive and Immersive Experience in Virtual Reality*" describes an approach to reconstruct and restore historic buildings and mural paintings [7]. The work process uses digital models that are then inserted into an interactive and immersive VR environment. Windows-Mixed Reality is used to visualize the said VR environment. The work method was applied at a United Nations Educational, Scientific and Cultural Organisation (UNESCO) World Heritage Site in Tenerife (Canary Islands, Spain), thereby creating a virtual three dimensional (3D) rendering of the architectural structures of the St. Augustine Church in La Laguna and its murals.

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