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Lucio Tommaso De Paolis · Patrick Bourdot (Eds.)

Augmented Reality, Virtual Reality, and Computer Graphics

5th International Conference, AVR 2018
Otranto, Italy, June 24–27, 2018
Proceedings, Part II

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Preface

Virtual Reality (VR) aims to develop computer systems that give humans the ability to perceive and interact in realistic multisensory motor ways, with 3D digital data or virtual worlds that are more or less realistic depending on the applications. Computer graphics is used to create a realistic visual scene, while physical-based rendering makes, for instance, 3D audio perception and haptic interactions possible. All this is meant to provide a feeling of immersion to the users (i.e., the sensation of being in a 3D world in a perceptive way), and even a feeling of presence (i.e., the sensation of being somewhere: apart from the immersive perception, this sensation targets cognitive factors, such as affordance of virtual objects and implication/involvement of users in their virtual activity).

Augmented Reality (AR) technology allows the real-time fusion of computer-generated digital content with the real world. Adding virtual content to reality makes it possible to understand information or knowledge of the real world that is not directly accessible, and/or may provide assistance to users during the execution of their tasks. Regarding the perception of immersion and feeling of presence, designing such 3D user interfaces remains challenging, but the result may greatly improve the accuracy of users' interaction in the real world, and the efficiency or even security of their activity.

Human–Computer Interaction (HCI) technology is a research area concerned with the design, implementation, and evaluation of interactive systems that make more simple and intuitive the interaction between user and computer.

This book contains the contributions to the 5th International Conference on Augmented Reality, Virtual Reality, and Computer Graphics (SALENTO AVR 2018) that has held in Otranto (Italy) during June 24–27, 2018. We cordially invite you to visit the SALENTO AVR website (<http://www.salentoavr.it>) where you can find all relevant information about this event.

SALENTO AVR 2018 intended to bring together researchers, scientists, and practitioners to discuss key issues, approaches, ideas, open problems, innovative applications, and trends in virtual and augmented reality, 3D visualization, and computer graphics in the areas of medicine, cultural heritage, arts, education, entertainment, as well as industrial and military sectors.

We are very grateful to the Program Committee and local Organizing Committee members for their support and for the time spent to review and discuss the submitted papers and for doing so in a timely and professional manner. We would like to sincerely thank the keynote and tutorial speakers who willingly accepted our invitation and shared their expertise through illuminating talks, helping us to fully meet the conference objectives.

In this edition of SALENTO AVR, we were honored to have the following invited speakers:

- Marco Sacco – ITIA-CNR, Italy
- Arcadio Reyes-Lecuona – Universidad de Malaga, Spain
- Roberto Pierdicca – Università Politecnica della Marche, Italy
- Marcello Carrozzino – Scuola Superiore Sant’Anna, Italy
- Donato Maniello – Studio Glowarp, Italy

We extend our thanks to the University of Salento for the enthusiastic acceptance to sponsor the conference and to provide support in the organization of the event.

We would also like to thank the EuroVR Association, which has supported the conference since its first issue, by contributing each year to the creation of the international Program Committee, proposing invited keynote speakers, and spreading internationally the announcements of the event.

SALENTO AVR attracted high-quality paper submissions from many countries. We would like to thank the authors of all accepted papers for submitting and presenting their work at the conference and all the conference attendees for making SALENTO AVR an excellent forum on virtual and augmented reality, facilitating the exchange of ideas, fostering new collaborations, and shaping the future of this exciting research field.

For greater readability, the papers are organized in two volumes and are classified into seven main parts:

- Virtual Reality
- Augmented and Mixed Reality
- Computer Graphics
- Human–Computer Interaction
- Applications of VR/AR in Medicine
- Applications of VR/AR in Cultural Heritage
- Applications of VR/AR in Industry

We hope the readers will find in these pages interesting material and fruitful ideas for their future work.

June 2018

Lucio Tommaso De Paolis
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Spatial Augmented Reality: A Way to Increase Content in Cultural Heritage Context (Tutorial)

Donato Maniello

Studio Glowarp, Italy

The technique called Spatial Augmented Reality – better known as video mapping – is constantly growing. Several fields of application have tested the potential and particularity of use. This contribution aims to discuss the well-known potential of this medium in the urban redevelopment through forms of “augmented architecture” and enhancement in the museum in the case of “augmented archaeology” and to expose some of the techniques used to map generic surfaces in relation to their complexity and size. This allows the construction of a workflow that transforms this raw data into useful contents to enhance the asset itself through multimedia installation and digital storytelling, taking care not to replace the asset itself.

In this way the user is not placed in front of the object in a detached manner, but is catapulted and projected into it, as if he were in a parallel reality. In this case video mapping becomes a medium through which the museum experience is integrated and completed, without going beyond the real world but simply making discernment easier and emphatic.

Keynote Speakers

Augmented and Virtual Reality Enabler for the “Factory 4.0”

Marco Sacco

ITIA-CNR, Italy

Manufacturing sector transformation (the so call Factory 4.0) requires the introduction of advanced tools for both the knowledge representation and simulation. For over 10 years, Virtual Reality and Augmented Reality have generated benefits in several sectors thanks to the potentialities offered by these visualisation technologies able to provide an added value to the contents and data enrichment.

Manufacturing companies, thanks to the reduction of cost and a widespread of devices, could now take advantage integrating AR/VR to simulation and emerging AI.

The result is a Virtual Factory, a full digital twin of the real plant, that could be used for several purposes, from design to monitoring and logistics, from reconfiguration to training. Some industrial applications will be presented.

3D Audio for VR Applications: Fundamentals and Practicalities

Arcadio Reyes-Lecuona

Universidad de Malaga, Spain

Immersive Virtual Reality has been experimenting a constant development and has become more and more popular in the last times. This development has been mainly focused in the visual modality. However, auditory stimuli can also be very powerful in creating immersive perceptions. In this context, three-dimensional localization of sound sources plays an important role in these systems.

3D audio techniques allow to produce the perception in the listener that a sound source is virtually located anywhere in the 3D space, including behind or above the listener. They are not new, but, with the advancements in computational power, it is now possible to perform the required processing in real time using affordable equipment. Therefore, the interest for 3D sound has been increasing.

Additionally, the environment modifies sound and this is especially relevant when simulating spatial sound. The perception of sound includes a combination of the original sound emitted by the source, modifications due to the environment and modifications produced by the listener's head. All those modifications can be characterized and applied in a simulation in order to virtually locate a source in a specific place within a given environment.

In this talk, the fundamentals of several techniques of 3D audio will be presented, with special attention to those more suitable for affordable Virtual Reality systems. More specifically, the potential of binaural audio and virtual Ambisonics will be presented. In addition to this, the role of the environment and how it can be considered will also be discussed. Finally, using 3D audio in a Virtual Reality system requires to know some basic concepts of real time audio, which will be addressed as well. Moreover, the main decisions and trade-off to be taken when implementing a 3D sound renderer will be discussed, presenting the practical implications of each of them.

Sensing Cultural Heritage: User-Centered Approaches Towards Senseable Spaces

Roberto Pierdicca

Università Politecnica della Marche, Italy

Cultural Heritage domain (both tangible and intangible) has witnessed, in the last decade, to a tremendous improvement on the way in which the users can be in contact with cultural goods. The reasons are many, but one can summarize all of them: ICT are everywhere, pervasive like never in the past, and at the same time more and more cheaper and available in the market. Following this wave, 3D reconstructions, new advanced interfaces, wireless connections and interactions are becoming the backbone for AR/VR experiences, which can be definitively defined as the mainstream for communicating and valorizing the priceless values of cultural goods in a more efficient way. State of art solutions for the development of such experiences are mature enough to allow an effective storytelling and are designed to be exploited by heterogeneous users.

However, several limitations still prevent the adoption of a real and efficient digital agenda for the management of Cultural Heritage. One of them, and probably the most urgent, is that digital experiences are developed by experts or insiders, without taking into account the real needs of the users. There is thus the necessity of adopting strategies to understand the users' behaviours by analysing and studying their habits, preferences and knowledge. Nowadays this process is made possible by the increasing miniaturization of new technologies, which allows providing contextual information to the users and, at the same time, to infer information from the digital footprints they leave (the so-called Users' Generated Data).

The talk, besides providing a complete overview of the latest achievements in the field of DCH, will provide prospective visions about a new paradigm of spaces (both indoor and outdoor) where a bidirectional exchange of information from the space to the user and vice versa is possible. These Spaces can be defined Senseable Spaces, which can be both indoor and outdoor scenario where the service to the users are designed following their behaviours and need, in a seamless way. To show the feasibility of such approach, some research projects (developed by a multi-disciplinary group) will be broadly discussed.

Opportunities of the Use of Embodied Agents in Virtual Reality for Cultural Heritage

Marcello Carrozzino

Scuola Superiore Sant'Anna, Italy

Virtual Reality is becoming an increasingly important tool for the research, the communication and the popularization of cultural heritage. However most of the available 3D interactive reconstructions of artefacts, monuments and sites often miss an important factor: human presence. Thanks to the advancements in the technology, in latest years Virtual Humans have started being used in a variety of cultural-related VR applications. From simple 2D characters to complex 3D avatars, technology continues to evolve and so is the adoption of virtual assistants in digital heritage. The acceptance of such tools deserves a greater attention from the scientific community.

This talk will explore the state-of-the-art on this subject, underlining the technological challenges and also analysing the effects of avatar interaction on user engagement, sense of immersion and learning effectiveness.

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