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Lucio Tommaso De Paolis · Antonio Mongelli (Eds.)

Augmented and Virtual Reality

First International Conference, AVR 2014

Lecce, Italy, September 17–20, 2014

Revised Selected Papers



Springer

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ISSN 0302-9743
Lecture Notes in Computer Science
ISBN 978-3-319-13968-5
DOI 10.1007/978-3-319-13969-2

ISSN 1611-3349 (electronic)
ISBN 978-3-319-13969-2 (eBook)

Library of Congress Control Number: 2014957958

LNCS Sublibrary: SL6 – Image Processing, Computer Vision, Pattern Recognition, and Graphics

Springer Cham Heidelberg New York Dordrecht London

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Printed on acid-free paper

Springer International Publishing AG Switzerland is part of Springer Science+Business Media
(www.springer.com)

Preface

This book contains the written contributions to the First International Conference on Augmented and Virtual Reality (SALENTO AVR 2014) that has held in Lecce (Italy), during September 17–20, 2014.

The aim of the SALENTO AVR 2014 has been to bring a community of researchers from academia and industry, computer scientists, engineers, physicians together in order to share points of views, knowledge, experiences and scientific and technical results, related to state-of-the-art solutions and technologies on virtual and augmented reality applications for medicine, cultural heritage, education, industrial sectors, as well as the demonstration of advanced products and technologies.

The papers spans topics from virtual/augmented/mixed reality (VR/AR/MR) to 3D user interfaces and the technology needed to enable these environments to a wide range of applications (medical, entertainment, military, design, manufacture, maintenance, arts, and cultural heritage).

The topics of the SALENTO AVR 2014 Conference were:

- input devices for VR/AR/MR
- 3D interaction for VR/AR/MR
- computer graphics techniques for VR/AR/MR
- advanced display technology
- haptic interfaces
- audio and other nonvisual interfaces
- tracking and sensing
- distributed VR/AR/MR
- VR toolkits
- modelling and simulation
- physical modelling
- perception and presence in virtual environment
- human-computer interface
- human-computer Interaction
- teleoperation and telepresence
- intuitive interactions and interfaces
- artificial life art
- interactive art
- navigation
- natural user interface
- gestural-based interaction
- interaction techniques for AR/MR
- collaborative learning environment
- augmented and mixed reality
- augmented visualization on mobile
- real-time 3D body reconstruction

- real-time capturing, compression, and rendering
- real-time gesture reconstruction
- body and facial animation
- behavioral simulation
- game design and development
- immersive gaming
- serious games
- VR/AR in minimally invasive surgery
- medical imaging processing, analysis, and visualization
- VR in preoperative surgical planning
- VR in surgical training
- VR in rehabilitation
- virtual patient
- VR/AR in education
- VR/AR in cultural heritage
- virtual museums and exhibitions
- VR in military simulation
- VR in spatial simulation
- VR in industrial simulation

We received 76 submissions from 15 countries. Each was been evaluated by at least two members of the Program Committee and external reviewers. Based on these reviews, 28 papers were selected for long oral presentations and 9 for poster talks. In addition to the contributed papers, 2 tutorials and 3 keynote speaker presentations were included in the conference program.

The geographical spread of the different institutions presenting their research was: Belgium, Brasil, Canada, Estonia, Italy, Kazakhstan, Latvia, Lithuania, Mexico, Pakistan, Poland, Sweden, Taiwan, UK and USA.

We are very grateful to Program Committee members for volunteering their time to review and discuss the submitted papers and doing so in a timely and professional manner. We extend our thanks to University of Salento and other sponsors for providing support in the organization of the event. Last but not least, we would like to thank all authors for presenting their work at the conference and we hope that all participants enjoyed the stimulating discussion as well as the opportunity to establish fruitful interactions.

September 2014

Lucio Tommaso De Paolis
Antonio Mongelli

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Tutorials

Virtual Reality and Augmented Visualization in Medicine and Surgery

Lucio Tommaso De Paolis

AVR Lab, University of Salento, Lecce, Italy

In medicine and surgery the Virtual Reality technology has made available new tools for diagnosis and therapy definition by translating the information contained in the medical images of the patients into 3D virtual models who are realistic replicas of real patients with their actual pathologies. This has allowed the development of a new form of medical education and training and the use of patient-specific surgical simulators has permitted to practice and rehearse the surgical procedures on digital clones of the real patients. New applications of Augmented Reality technology, by means of the overlapping of virtual information on the real patient, provide systems that help surgeons in the intra-operative phase and permit to perform their tasks in ways that are both faster and safer. The use of the augmented visualization in surgery has the potential to bring the advantages of the open-surgery visualization also in the minimally invasive surgery.

Lucio Tommaso De Paolis is an Assistant Professor of Information Processing Systems and the scientific responsible of the Augmented and Virtual Reality Laboratory (AVR Lab) at the Department of Engineering for Innovation of the University of Salento, Italy; he is also the responsible of the “Advanced Techniques of Virtual Reality for Medicine” research group of the DReAM (Laboratory of Interdisciplinary Research Applied to Medicine) located at the Hospital of Lecce, Italy.

He received the Master Degree in Electronic Engineering from the University of Pisa (Italy) in 1994 and after, first at the Scuola Superiore S. Anna of Pisa and then at the University of Salento, his research interest concerns the study of realistic simulators for surgical training and the development of applications of Virtual and Augmented Reality in medicine and surgery.

De Paolis has been in 2014 visiting professor at the Tallinn Technical University of Tallinn (Estonia), in 2012 visiting professor at the Vytautas Magnus University of Kaunas (Lithuania), in 2011 visiting professor at the University of Tallinn (Estonia), in 2007 and 2010 visiting researcher at the Centro de Ciencias Aplicadas y Desarrollo Tecnológico (CCADET) – Universidad Nacional Autónoma de México (UNAM) – Mexico City (Messico), and in 2007 and 2009 visiting researcher at Computer Graphics Laboratory, Sabanci University of Istanbul (Turkey).

Development of Immersive VR Applications Using XVR

Marcello Carrozzino

PERCRO Lab, Scuola Superiore S. Anna, Pisa, Italy

The tutorial will explain the basics on how to program a in immersive VR application using the XVR technology, tackling general VR framework considerations and focusing on the most recent development in the field of managing immersive devices such as CAVEs and HMDs. Live examples of CAVE and Oculus Rift-based XVR applications will be provided, together with interesting insights on the uses of such technologies for mixed reality applications.

Marcello Carrozzino is an Assistant Professor of Computer Graphics and Virtual Reality. His activities deal with the integration of Virtual Reality systems and Cultural Heritage applications. Since 2005 he has been teaching the course of Virtual Environments held at the Computer Science Department of the University of Pisa. In 2006 he attained a Ph.D. at Scuola Superiore S. Anna in Pisa with a thesis on Efficient Management of Complex Virtual Environments. From 2006 to 2009 he has been Assistant Professor at IMT Lucca in the area of Technology and Management of Cultural Heritage. He is a founder of VRMedia s.r.l, a spin-off company of Scuola Superiore S. Anna in Pisa. Since 2000 he has been collaborating with Scuola Superiore S. Anna, where he is currently heading the Art, Cultural and Education Group of PERCRO Lab. He is a founder of the Mnemosyne Digital Culture association and has participated to several EU research projects, leaded regional projects, and authored or co-authored more than sixty publications in journals, conference proceedings and book chapters.

Keynote Speakers

Fully Immersive Modification of Native CAD Data During Project Reviews: Recent Results and Remaining Issues

Patrick Bourdot

CNRS/LIMSI, University Paris-Sud, France

This talk focuses on recent results on VR and CAD integration to make possible direct and interactive modifications of CAD objects in immersive Virtual Environments (VE). Using CAD software requires some skills (experience and knowledge), on its functionalities and representations, as well as on objects (principally on their design history). On the other hand, VR brings new interactive paradigms of 3D interaction, and one needs intelligent middleware to manage CAD objects in immersive VE

After an overview of the main approaches in the VR-CAD integration field, we focus on an extension of one of our previous work which proposed a mechanism allowing implicit edition of the Construction History Graphs (CHG) of CAD objects via a direct manipulation of their 3D visual representations. Based on labelling technique of the Boundary Representations (B-Rep) elements, and coupled with an inference engine, this mechanism is providing a backward chaining of B-Rep elements towards the operators of the CHG. However, we had demonstrated that this approach up today only on a dedicated CHG and specific persistent naming developed in the OpenCASCADE framework. Recent results on the generalization of our approach makes possible to apply it to marketed CAD systems, software generally chose by industrials for a number of years.

Firstly, this generalization aims to propose an architecture based on a VR-CAD data model to apply our backward chaining mechanism to any CAD system based on B-Rep and CHG models. Several encapsulations structures are proposed, to manage CHG operators and their parameters, as well as the B-Rep components. Secondly, the B-Rep labelling, now attached to these structures, has been extended to enable multiple backward chaining, as some B-Rep elements may be the result of several CHG operators, so that alternate decisions may be inferred from their manipulation. These improvements make it possible to access direct and interactive modifications of existing CAD objects by parsing their CHG to fill our structures with useful data. Moreover the multiple backward-chaining mechanism grants the manipulation of CAD objects to non-experts through the inference engine. As a proof of concept of our VR-CAD model, we detail the application of our approach on CATIA, then we conclude on the remaining issues and future works.

Patrick Bourdot is Research Director at CNRS and head of VENISE team (<http://www.limsi.fr/venise/>), the Virtual & Augmented Reality (V&AR) research group he has created in 2001 at CNRS/LIMSI lab. Architect graduated in 1986, he received his PhD in Computer Sciences at the University of Aix-Marseille in 1992, joined the CNRS/LIMSI lab in 1993. His main research focuses are multi-sensorimotor, multi-modal and collaborative V&AR interactions, and the related issues for users' perception

and cognition. He coordinated the scientific partnership of his Lab or led a number of research projects that have been or are currently funded by French government (RNTL, ANR), or by national or regional research institutes (CNRS, DIGITEO). He has been the founding secretary of AFRV, the French association of V&AR, and co-chaired its 5th conference (<http://afrv2010.limsi.fr/>). At the international level, one of his actions has been to manage the CNRS Labs involved in INTUITION, the NoE of the 6th IST framework focused on V&AR, where he was member of the Core Group. He is founding member of EuroVR (www.eurovr-association.org), and has been re-elected last year to its Executive Board. He organised the first Special Interest Groups meeting of EuroVR (<http://eurovr-eve-2010.limsi.fr/>), during the inauguration of the EVE system, an innovative CAVE-like setup, whose he defined the specification and implemented with the VENISE team. He is presently organizing JVRC 2013, the 5th Joint Virtual Reality Conference of EGVE and EuroVR (<http://jvrc2013.sciencesconf.org/>), which will take this December in Paris area. Patrick Bourdot has a large number of international publications in most important V&AR conferences such as IEEE VR, ACM VRST, IEEE 3DUI or EGVE, and many others international or national papers in the fields of 3D modelling, 3D reconstruction, and HCI. He has been or is reviewer or expert for several national and international journals, conferences or research agencies.

Simplifying Creation of VR/AR Applications for Domain Experts

Krzysztof Walczak

Department of Information Technology
Poznan University of Economics, Poland

One of the main obstacles, which currently limits wider use of virtual and augmented reality applications on everyday basis is the difficulty associated with the creation of useful 3D content. Non-trivial, interactive 3D multimedia content is inherently difficult to create. Not only geometry and appearance of particular elements must be properly represented, but also temporal, structural, logical and behavioural aspects must be taken into account. Moreover, creation of useful content requires participation of domain experts in this process. For example, a virtual museum exhibition should be set up by a museum curator, while an augmented reality lesson should be designed by an experienced teacher.

In this presentation, a range of methods aiming at simplification of the creation of interactive 3D content by domain experts are discussed. These methods include:

- content componentisation – which enables the content to be configured from pre-designed – possibly parameterised – blocks (geometrical, logical or behavioural);
- narrowing the application domain – which enables to increase the quality of the created content, but at the same time limits the generality of the solution;
- narrowing content variability – which enables creating more complex content at the cost of limited possibilities of content customisation.

Content can be also created collaboratively by groups of authors resulting in smaller and more manageable tasks assigned to particular designers. Moreover, the whole content creation process can be divided into distinct phases, which can be performed by designers with different responsibilities, skills and tools.

A promising research direction aiming at simplification of 3D content creation is semantic content modelling. Semantic modelling enables creation of 3D content using domain-specific ontologies, which domain experts are familiar with. Creation of an interactive 3D scene consists then in building a semantic knowledge base using known domain-specific concepts. Such a knowledge base may be created using a variety of tools – from text-based semantic editors to semantically-enabled graphical 3D authoring packages.

Krzysztof Walczak received the M.Sc. degree in Electronics and Telecommunications in 1992 and in Computer Science in 1994, both from the Technical University of Poznan. He received the Ph.D. degree in Computer Science in 2001 from the Technical University of Gdansk. From 1992 to 1996 he was with the Franco-Polish School of New Information and Communication Technologies in Poznan. He spent over one year as an invited researcher at the Syracuse University, NY, USA. In 1996 he joined

the Department of Information Technology at the Poznan University of Economics, where currently he is an associate professor. His current research interests include virtual reality systems, multimedia systems, distance learning and semantic web. He was acting as a technical coordinator in numerous research and industrial projects in these domains. He is a member of Executive Committee of EuroVR Association, ACM (Association for Computing Machinery), Web3D Consortium and Board of Directors of VSMM (International Society on Virtual Systems and Multimedia).

Virtual Worlds: A Perfect Convergence Between Real and Virtual Life

Davide Borra

NoReal.it, Italy

In a future work, daily life, health, and social relationships will be mediated by our virtual alter-ego. Is the “metaverse” or “virtual world”, a sintetic on-line environment, when our avatar can explore and build our space, van exchange, buy and sell our creations and abilities, when my expressions will be replicate in real-time on my avatar’s face. It is virtual, aumented or mixed reality? What is difference from what we already know about the cybernetic suites, the oculus visors, the immersive caves used in the differents manufacture fields?

Second Life, Active Worlds and the others on-line platforms are always operatives?

I think we are in front to a singularity point of the digital humanism: we can be immersed in a metaverse in a real-scale, with a series of good wearable devices, in a very comfortable psycological status, with a realistic multisensorial feedbacks.

The technology is quite ready to offer a domestic environment and we are ready to offer to our avatar, a series of personal “messages” that it (or he/she?) can use in a social relationships to be more natural the communication.

Real-scale, device usability, humanization of communication. Three impact factors to make the perfect convergence between real and virtual worlds.

Davide Borra is an architect with PHD in Environment and Territory (Politecnico di Torino) and has about twenty years of experience in designing and creating of multi-platform 3D contents in the area of cultural heritage, architecture and communications company.

The 3D model genesi and the importance of the user in the information cycle based on virtuality, are the main topics of his research in both academic and vocational education, which resulted in applications for museums and exhibit and in a number of scientific articles published.

The last experiments concern the latest Mobile 3D, 3D Metaverses on-line and the Augmented Reality.

For a decade, he taught 3D in the Faculty of Architecture of the Politecnico di Torino and Milan.

In 1999 he founded NoReal [www.noreal.it], a company specialized in Virtual Cultural Heritage, which currently manages.

Since 2008 he is the President of MIMOS (Italian Movement of Modelling and Simulation) [www.mimos.it].

Actually he is one of the international experts invited to discuss about the principles of the Virtual Cultural Heritage around the London Charter and the Sevilla Principles.

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