Lecture Notes in Computer Science 10605

Commenced Publication in 1973
Founding and Former Series Editors:
Gerhard Goos, Juris Hartmanis, and Jan van Leeuwen

Editorial Board

David Hutchison
Lancaster University, Lancaster, UK
Takeo Kanade
Carnegie Mellon University, Pittsburgh, PA, USA
Josef Kittler
University of Surrey, Guildford, UK
Jon M. Kleinberg
Cornell University, Ithaca, NY, USA
Friedemann Mattern
ETH Zurich, Zurich, Switzerland
John C. Mitchell
Stanford University, Stanford, CA, USA
Moni Naor
Weizmann Institute of Science, Rehovot, Israel
C. Pandu Rangan
Indian Institute of Technology Madras, Chennai, India
Bernhard Steffen
TU Dortmund University, Dortmund, Germany
Demetri Terzopoulos
University of California, Los Angeles, CA, USA
Doug Tygar
University of California, Berkeley, CA, USA
Gerhard Weikum
Max Planck Institute for Informatics, Saarbrücken, Germany

More information about this series at http://www.springer.com/series/7409

Marinos Ioannides (Ed.)

Digital Cultural Heritage

Final Conference
of the Marie Skłodowska-Curie Initial Training Network
for Digital Cultural Heritage, ITN-DCH 2017
Olimje, Slovenia, May 23–25, 2017
Revised Selected Papers

Springer

Editor
Marinos Ioannides
Cyprus University of Technology
Limassol
Cyprus

ISSN 0302-9743 ISSN 1611-3349 (electronic)
Lecture Notes in Computer Science
ISBN 978-3-319-75825-1 ISBN 978-3-319-75826-8 (eBook)
https://doi.org/10.1007/978-3-319-75826-8

Library of Congress Control Number: 2018934337

LNCS Sublibrary: SL3 – Information Systems and Applications, incl. Internet/Web, and HCI

© Springer International Publishing AG, part of Springer Nature 2018
The chapter "Digital Preservation: How to Be Trustworthy" is licensed under the terms of the Creative Commons Attribution 4.0 International License (http://creativecommons.org/licenses/by/4.0/). For further details see license information in the chapter.
This work is subject to copyright. All rights are reserved by the Publisher, whether the whole or part of the material is concerned, specifically the rights of translation, reprinting, reuse of illustrations, recitation, broadcasting, reproduction on microfilms or in any other physical way, and transmission or information storage and retrieval, electronic adaptation, computer software, or by similar or dissimilar methodology now known or hereafter developed.
The use of general descriptive names, registered names, trademarks, service marks, etc. in this publication does not imply, even in the absence of a specific statement, that such names are exempt from the relevant protective laws and regulations and therefore free for general use.
The publisher, the authors and the editors are safe to assume that the advice and information in this book are believed to be true and accurate at the date of publication. Neither the publisher nor the authors or the editors give a warranty, express or implied, with respect to the material contained herein or for any errors or omissions that may have been made. The publisher remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

Cover illustration: The images on the cover are taken from the paper "Rapid Reconstruction and Simulation of Real Characters in Mixed Reality Environments" by M. Papaefthimiou et al. on page 275. They represent the reconstructed monument of ASINOU, which belongs to the UNESCO WHL (http://whc.unesco.org/en/list/351). The upper image illustrates the monument and the lower one the virtual reality representation of the Priest and the frescos of the monument. The church is located on the southern part of Nikitari village on the foothills of the Troodos Mountains in Cyprus (https://www.byzantinecyprus.com/).
The ASINOU monument has been used as the first case study during the research training activities of all the ITN-DCH fellows (http://www.itn-dch.eu/index.php/case-studies/asinou/).

Printed on acid-free paper

This Springer imprint is published by the registered company Springer International Publishing AG
part of Springer Nature
The registered company address is: Gewerbestrasse 11, 6330 Cham, Switzerland

Preface

The Marie Skłodowska-Curie Initial Training Network for Digital Cultural Heritage: Projecting Our Past to the Future (acronym, ITN-DCH) was the first and one of the largest fellowship projects in the area of the e-documentation/e-preservation and CH protection funded by the European Union under the EU FP7 PEOPLE research framework (www.itn-dch.eu). The project started on October 1, 2013, and its consortium comprises 14 full partners and 10 associate members covering the entire spectrum of European CH actors, ranging from academia, research institutions, industry, museums, archives, and libraries. The project aimed to train 20 fellows (16 ESRs and 4 ERs – 500 person months) in the area of CH digital documentation, preservation, and protection in order to provide them with a strong academic profile and market-oriented skills, which will significantly contribute to their career prospects. The consortium and the fellows training program were supported by a prestigious advisory board.

ITN-DCH aimed—for the first time worldwide—to analyze, design, research, develop, and validate an innovative multidisciplinary and intersectorial research training framework that covers the entire lifecycle of digital CH (DCH) research for a cost-effective preservation, documentation, protection, and presentation of cultural heritage. CH is an integral element of Europe and vital for the creation of a common European identity and one of the greatest assets for steering Europe's social and economic development as well as job creation. However, the current research training activities in CH are fragmented and mostly designed to be of a single discipline, failing to cover the whole lifecycle of DCH research, which is by nature multidisciplinary and intersectorial. The training targeted all aspects of CH ranging from tangible (books, newspapers, images, drawings, manuscripts, uniforms, maps, artifacts, archaeological sites, monuments) to intangible content (e.g., music, performing arts, folklore, theatrical performances) and their inter-relationships. The project aimed to boost the added value of CH assets by re-using them in real application environments (protection of CH, education, tourism industry, advertising, fashion, films, music, publishing, video games, and TV) through research on (a) new personalized, interactive, mixed, and augmented reality-enabled e-services, (b) new recommendations in data acquisition, (c) new forms of representations (3D/4D) of both tangible/intangible assets, and (d) interoperable metadata forms that allow for easy data exchange and archiving.

The project was structured in training modules and had as a milestone event a public final conference open to the public. The ITN-DCH fellows as well as other researchers from outside our project had to present their latest research results. The ITN-DCH fellows were responsible for the planning and organization of this unique event, which took place at Olimje in Slovenia in May 2017.

The presented papers were reviewed by the majority of the fellows and their supervisors and illustrate the state of the art in research and development in the area of DCH.

Here, we present 29 papers, selected from more than 100 submissions, which focus on interdisciplinary and multidisciplinary research concerning cutting-edge CH informatics, physics, chemistry, and engineering and the use of technology for the representation, documentation, archiving, protection, preservation, and communication of CH knowledge.

Our keynote speakers Eleanor E. Fink, Alex Yen, and Pavlos Chatzigrigoriou are not only experts in their fields but also visionaries for the future of CH protection and preservation. They promote the e-documentation and protection of the past in such a way for its preservation for the generations to come.

We extend our thanks to all authors, speakers, and everyone whose labor and encouragement made the ITN-DCH final event possible. The Organizing Committee, whose members represent a cross-section of archaeology, physics, chemistry, civil engineering, computer science, graphics and design, library, archive, and information science, architecture, surveying, history and museology, worked tenaciously and finished their work on time.

We express our thanks and appreciation to all the project advisors for their enthusiasm, commitment, free-of-charge work and support for the success of this project and the event. Most of all we would like to thank all the ITN-DCH fellows and the European Commission, CIPA, ISPRS and ICOMOS that entrusted us with the task of organizing and undertaking this unique event.

December 2017 Marinos Ioannides

Organization

General Chair

Marinos Ioannides	Cyprus University of Technology, Cyprus

Scientific Committee

Anais Guillem	University of Ljubljana, Slovenia
Chance Michael Coughenour	University of Stuttgart, Germany
Diego Bellido Castaneda	Arctron3D, Germany
Eirini Papageorgiou	Cyprus University of Technology, Cyprus
Elisavet Konstantina Stathopoulou	National University of Athens, Greece
Emmanouil Alexakis	National University of Athens, Greece
George Bruseker	FORTH, Greece
Georgios Leventis	Cyprus University of Technology, Cyprus
Gina Stavropoulou	KU Leuven, Belgium
Louis Cuel	MiraLab, University of Geneva, Switzerland
Magdalena Ramos Calles	FBK, Italy
Margarita Papaefthymiou	FORTH, Greece
Marleen de Kramer	7 Reasons Medien GmbH, Austria
Matevz Domajnko	Fraunhofer IGD, Germany
Matthew Luke Vincent	University of Murcia, Spain
Nicola Carboni	Centre Nationale de la Recherche Scientifique (CNRS), France
Nikoletta Skordaki	University of Ljubljana, Slovenia
Rossella Suma	University of Warrick, UK
Simon Senecal	MiraLab, University of Geneva, Switzerland
Vasiliki Nikolakopoulou	Cyprus University of Technology, Cyprus

Organizing Committee

Nicola Carboni	Centre Nationale de la Recherche Scientifique (CNRS), France
Margarita Papaefthymiou	FORTH, Greece
Vasiliki Nikolakopoulou	Cyprus University of Technology, Cyprus
Georgios Leventis	Cyprus University of Technology, Cyprus
Pavlos Chatzigrigoriou	Cyprus University of Technology, Cyprus
Matevz Domajnko	Fraunhofer IGD, Germany

Local Committee

Roko Zarnic	President of SAEE, Slovenia
Meta Kržan	Secretary General of SAEE, Slovenia

Acknowledgment and Disclaimer

The Marie Skłodowska-Curie Initial Training Network for Digital Cultural Heritage (ITN-DCH) final conference has been part of the training activity of all the project's fellows, supported by the EU FP7-PEOPLE 2012/3 Programme.

However, the content of this publication reflects only the authors' views and the European Commission, the CIPA, ICOMOS, Cyprus University of Technology, all the ITN-DCH partners/institutions, supervisors and associated partners/institutions, the Slovenian Association for Earthquake Engineering (SAEE) and the EU projects FP7 PEOPLE ITN2013 ITN-DCH and IAPP2012 4D-CH-WORLD, the DARIAH-EU ERIC, the EU DARIAH-CY, the EU H2020 INCEPTION, the EU H2020 CSA ViMM, the CIP ICT-PSP Europeana-Space, the CIP ICT-PSP LoCloud and the EU COST Action TD1406 projects are not liable for any use that may be made of the information contained herein.

Contents

3D Data Acquisition and Modelling of Complex Heritage Buildings 1
Federica Maietti, Roberto Di Giulio, Marcello Balzani, Emanuele Piaia, Marco Medici, and Federico Ferrari

Low Cost 3D Surveying Methodologies: Colors and Dimensional Accuracy in the Case Study of the Island of Procida, Italy 14
Maria Chiara Pugliese and Cristiana Bartolomei

3D Digitization of Selected Collection Items Using Photometric Stereo 31
Jaroslav Valach, Jan Bryscejn, Tomáš Fíla, Daniel Vavřík, and Petra Štefcová

A DICOM-Inspired Metadata Architecture for Managing Multimodal Acquisitions in Cultural Heritage 37
Irina-Mihaela Ciortan, Ruggero Pintus, Giacomo Marchioro, Claudia Daffara, Enrico Gobbetti, and Andrea Giachetti

Knowledge Management Using Ontology on the Domain of Artworks Conservation 50
Efthymia Moraitou and Evangelia Kavakli

Ontology-Based Data Collection for Heritage Buildings 63
Andrej Tibaut, Branko Kaučič, and Daniela Dvornik Perhavec

Linked Open Data as Universal Markers for Mobile Augmented Reality Applications in Cultural Heritage 79
John Aliprantis, Eirini Kalatha, Markos Konstantakis, Kostas Michalakis, and George Caridakis

Semantic Representation and Enrichment of Cultural Heritage Information for Fostering Reinterpretation and Reflection on the European History 91
Andreas Vlachidis, Antonis Bikakis, Daphne Kyriaki-Manessi, Ioannis Triantafyllou, Joseph Padfield, and Kalliopi Kontiza

Digital Cultural Heritage: Semantic Enrichment and Modelling in BIM Environment 104
Federica Maietti, Marco Medici, Federico Ferrari, Anna Elisabetta Ziri, and Peter Bonsma

Building Information Modeling for Cultural Heritage: The Management of Generative Process for Complex Historical Buildings. 119
F. Banfi, L. Chow, M. Reina Ortiz, C. Ouimet, and S. Fai

Innovative Business Plans for H-BIM Application Related to Alternative Financing Opportunities for Cultural Heritage 131
Klaus Luig, Dieter Jansen, Federica Maietti, Luca Coltro, and Dimitrios Karadimas

3D Models of Ancient Greek Collection of the Perm University History Museum: Creation and Use 144
Nadezhda Povroznik

Towards a Digital Infrastructure for Illustrated Handwritten Archives 155
Andreas Weber, Mahya Ameryan, Katherine Wolstencroft, Lise Stork, Maarten Heerlien, and Lambert Schomaker

Anchoring Unsorted E-Sources About Heritage Artefacts in Space and Time 167
Gamze Saygi, Jean-Yves Blaise, and Iwona Dudek

Using Innovative Technologies in Preservation and Presentation of Endangered Archives 179
Aleksandar Jerkov and Vasilije Milnovic

Analysis, Documentation and Proposal for Restoration and Reuse of the "Chrysalis" Silk Factory in Goumenissa, Kilkis, Northern Greece 189
Stavros Apotsos, Athanasios Giamas, Leandros Zoidis, Despoina Ioannidou, Nikolaos Karagiannis, Zoe Kokkinou, Eleni Marinakou, Vasiliki Masen, Maria Miza, Effrosyni Bilmpili, Dimitrios Papadimitriou, Christina Papaoikonomou, Athena Siafaka, Ioannis Tavlarios, and Kiriaki Vasteli

The Loom: Interactive Weaving Through a Tangible Installation with Digital Feedback 199
Anastasios Dimitropoulos, Konstantinos Dimitropoulos, Angeliki Kyriakou, Maximos Malevitis, Stelios Syrris, Stella Vaka, Panayiotis Koutsabasis, Spyros Vosinakis, and Modestos Stavrakis

Design of 3D and 4D Apps for Cultural Heritage Preservation 211
Dieter Fritsch and Michael Klein

Digital Heritage and 3D Printing: Trans-media Analysis and the Display of Prehistoric Rock Art from Valcamonica 227
Marcel Karnapke and Frederick Baker

The Conservation of Cultural Heritage in Conditions of Risk, with 3D Printing on the Architectural Scale 239
Sara Codarin

Virtual Reality Annotator: A Tool to Annotate Dancers in a Virtual Environment 257
Claudia Ribeiro, Rafael Kuffner, and Carla Fernandes

Rapid Reconstruction and Simulation of Real Characters in Mixed Reality Environments 267
Margarita Papaefthymiou, Marios Evangelos Kanakis, Efstratios Geronikolakis, Argyrios Nochos, Paul Zikas, and George Papagiannakis

3D Pose Estimation Oriented to the Initialization of an Augmented Reality System Applied to Cultural Heritage 277
Ricardo M. Rodriguez, Rafael Aguilar, Santiago Uceda, and Benjamín Castañeda

Exploring Cultural Heritage Using Virtual Reality 289
Laurent Debailleux, Geoffrey Hismans, and Natacha Duroisin

3D Visualisation of a Woman's Folk Costume 304
Tanja Nuša Kočevar, Barbara Naglič, and Helena Gabrijelčič Tomc

The VR Kiosk: Using Virtual Reality to Disseminate the Rehabilitation Project of the Canadian Parliament Buildings 324
K. Graham, S. Fai, A. Dhanda, L. Smith, K. Tousant, E. Wang, and A. Weigert

Technologies of Non Linear Storytelling for the Management of Cultural Heritage in the Digital City: The Case of Thessaloniki 337
Ofilia I. Psomadaki, Charalampos A. Dimoulas, George M. Kalliris, and Gregory Paschalidis

Minimal Functionality for Digital Scholarly Editions 350
Federico Caria and Brigitte Mathiak

Digital Preservation: How to Be Trustworthy 364
Lina Bountouri, Patrick Gratz, and Fulgencio Sanmartin

Author Index 375