Lecture Notes in Artificial Intelligence 12776

Subseries of Lecture Notes in Computer Science

Series Editors

Randy Goebel
University of Alberta, Edmonton, Canada
Yuzuru Tanaka
Hokkaido University, Sapporo, Japan
Wolfgang Wahlster
DFKI and Saarland University, Saarbrücken, Germany

Founding Editor

Jörg Siekmann
DFKI and Saarland University, Saarbrücken, Germany

More information about this subseries at http://www.springer.com/series/1244

Dylan D. Schmorrow · Cali M. Fidopiastis (Eds.)

Augmented Cognition

15th International Conference, AC 2021
Held as Part of the 23rd HCI International Conference, HCII 2021
Virtual Event, July 24–29, 2021
Proceedings

Springer

Editors
Dylan D. Schmorrow
Soar Technology Inc.
Orlando, FL, USA

Cali M. Fidopiastis
Design Interactive, Inc.
Orlando, FL, USA

ISSN 0302-9743 ISSN 1611-3349 (electronic)
Lecture Notes in Artificial Intelligence
ISBN 978-3-030-78113-2 ISBN 978-3-030-78114-9 (eBook)
https://doi.org/10.1007/978-3-030-78114-9

LNCS Sublibrary: SL7 – Artificial Intelligence

© Springer Nature Switzerland AG 2021
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, expressed 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.

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

Foreword

Human-Computer Interaction (HCI) is acquiring an ever-increasing scientific and industrial importance, and having more impact on people's everyday life, as an ever-growing number of human activities are progressively moving from the physical to the digital world. This process, which has been ongoing for some time now, has been dramatically accelerated by the COVID-19 pandemic. The HCI International (HCII) conference series, held yearly, aims to respond to the compelling need to advance the exchange of knowledge and research and development efforts on the human aspects of design and use of computing systems.

The 23rd International Conference on Human-Computer Interaction, HCI International 2021 (HCII 2021), was planned to be held at the Washington Hilton Hotel, Washington DC, USA, during July 24–29, 2021. Due to the COVID-19 pandemic and with everyone's health and safety in mind, HCII 2021 was organized and run as a virtual conference. It incorporated the 21 thematic areas and affiliated conferences listed on the following page.

A total of 5222 individuals from academia, research institutes, industry, and governmental agencies from 81 countries submitted contributions, and 1276 papers and 241 posters were included in the proceedings to appear just before the start of the conference. The contributions thoroughly cover the entire field of HCI, addressing major advances in knowledge and effective use of computers in a variety of application areas. These papers provide academics, researchers, engineers, scientists, practitioners, and students with state-of-the-art information on the most recent advances in HCI. The volumes constituting the set of proceedings to appear before the start of the conference are listed in the following pages.

The HCI International (HCII) conference also offers the option of 'Late Breaking Work' which applies both for papers and posters, and the corresponding volume(s) of the proceedings will appear after the conference. Full papers will be included in the 'HCII 2021 - Late Breaking Papers' volumes of the proceedings to be published in the Springer LNCS series, while 'Poster Extended Abstracts' will be included as short research papers in the 'HCII 2021 - Late Breaking Posters' volumes to be published in the Springer CCIS series.

The present volume contains papers submitted and presented in the context of the 15th International Conference on Augmented Cognition (AC 2021), an affiliated conference to HCII 2021. I would like to thank the Co-chairs, Dylan D. Schmorrow and Cali M. Fidopiastis, for their invaluable contribution to its organization and the preparation of the proceedings, as well as the members of the Program Board for their contributions and support. This year, the AC affiliated conference has focused on topics related to brain-computer interfaces and brain activity measurement, physiological measuring and human performance, modeling human cognition, and applications of the above in complex environments.

I would also like to thank the Program Board Chairs and the members of the Program Boards of all thematic areas and affiliated conferences for their contribution towards the highest scientific quality and overall success of the HCI International 2021 conference.

This conference would not have been possible without the continuous and unwavering support and advice of Gavriel Salvendy, founder, General Chair Emeritus, and Scientific Advisor. For his outstanding efforts, I would like to express my appreciation to Abbas Moallem, Communications Chair and Editor of HCI International News.

July 2021 Constantine Stephanidis

HCI International 2021 Thematic Areas and Affiliated Conferences

Thematic Areas

- HCI: Human-Computer Interaction
- HIMI: Human Interface and the Management of Information

Affiliated Conferences

- EPCE: 18th International Conference on Engineering Psychology and Cognitive Ergonomics
- UAHCI: 15th International Conference on Universal Access in Human-Computer Interaction
- VAMR: 13th International Conference on Virtual, Augmented and Mixed Reality
- CCD: 13th International Conference on Cross-Cultural Design
- SCSM: 13th International Conference on Social Computing and Social Media
- AC: 15th International Conference on Augmented Cognition
- DHM: 12th International Conference on Digital Human Modeling and Applications in Health, Safety, Ergonomics and Risk Management
- DUXU: 10th International Conference on Design, User Experience, and Usability
- DAPI: 9th International Conference on Distributed, Ambient and Pervasive Interactions
- HCIBGO: 8th International Conference on HCI in Business, Government and Organizations
- LCT: 8th International Conference on Learning and Collaboration Technologies
- ITAP: 7th International Conference on Human Aspects of IT for the Aged Population
- HCI-CPT: 3rd International Conference on HCI for Cybersecurity, Privacy and Trust
- HCI-Games: 3rd International Conference on HCI in Games
- MobiTAS: 3rd International Conference on HCI in Mobility, Transport and Automotive Systems
- AIS: 3rd International Conference on Adaptive Instructional Systems
- C&C: 9th International Conference on Culture and Computing
- MOBILE: 2nd International Conference on Design, Operation and Evaluation of Mobile Communications
- AI-HCI: 2nd International Conference on Artificial Intelligence in HCI

List of Conference Proceedings Volumes Appearing Before the Conference

1. LNCS 12762, Human-Computer Interaction: Theory, Methods and Tools (Part I), edited by Masaaki Kurosu
2. LNCS 12763, Human-Computer Interaction: Interaction Techniques and Novel Applications (Part II), edited by Masaaki Kurosu
3. LNCS 12764, Human-Computer Interaction: Design and User Experience Case Studies (Part III), edited by Masaaki Kurosu
4. LNCS 12765, Human Interface and the Management of Information: Information Presentation and Visualization (Part I), edited by Sakae Yamamoto and Hirohiko Mori
5. LNCS 12766, Human Interface and the Management of Information: Information-rich and Intelligent Environments (Part II), edited by Sakae Yamamoto and Hirohiko Mori
6. LNAI 12767, Engineering Psychology and Cognitive Ergonomics, edited by Don Harris and Wen-Chin Li
7. LNCS 12768, Universal Access in Human-Computer Interaction: Design Methods and User Experience (Part I), edited by Margherita Antona and Constantine Stephanidis
8. LNCS 12769, Universal Access in Human-Computer Interaction: Access to Media, Learning and Assistive Environments (Part II), edited by Margherita Antona and Constantine Stephanidis
9. LNCS 12770, Virtual, Augmented and Mixed Reality, edited by Jessie Y. C. Chen and Gino Fragomeni
10. LNCS 12771, Cross-Cultural Design: Experience and Product Design Across Cultures (Part I), edited by P. L. Patrick Rau
11. LNCS 12772, Cross-Cultural Design: Applications in Arts, Learning, Well-being, and Social Development (Part II), edited by P. L. Patrick Rau
12. LNCS 12773, Cross-Cultural Design: Applications in Cultural Heritage, Tourism, Autonomous Vehicles, and Intelligent Agents (Part III), edited by P. L. Patrick Rau
13. LNCS 12774, Social Computing and Social Media: Experience Design and Social Network Analysis (Part I), edited by Gabriele Meiselwitz
14. LNCS 12775, Social Computing and Social Media: Applications in Marketing, Learning, and Health (Part II), edited by Gabriele Meiselwitz
15. LNAI 12776, Augmented Cognition, edited by Dylan D. Schmorrow and Cali M. Fidopiastis
16. LNCS 12777, Digital Human Modeling and Applications in Health, Safety, Ergonomics and Risk Management: Human Body, Motion and Behavior (Part I), edited by Vincent G. Duffy
17. LNCS 12778, Digital Human Modeling and Applications in Health, Safety, Ergonomics and Risk Management: AI, Product and Service (Part II), edited by Vincent G. Duffy

18. LNCS 12779, Design, User Experience, and Usability: UX Research and Design (Part I), edited by Marcelo Soares, Elizabeth Rosenzweig, and Aaron Marcus
19. LNCS 12780, Design, User Experience, and Usability: Design for Diversity, Well-being, and Social Development (Part II), edited by Marcelo M. Soares, Elizabeth Rosenzweig, and Aaron Marcus
20. LNCS 12781, Design, User Experience, and Usability: Design for Contemporary Technological Environments (Part III), edited by Marcelo M. Soares, Elizabeth Rosenzweig, and Aaron Marcus
21. LNCS 12782, Distributed, Ambient and Pervasive Interactions, edited by Norbert Streitz and Shin'ichi Konomi
22. LNCS 12783, HCI in Business, Government and Organizations, edited by Fiona Fui-Hoon Nah and Keng Siau
23. LNCS 12784, Learning and Collaboration Technologies: New Challenges and Learning Experiences (Part I), edited by Panayiotis Zaphiris and Andri Ioannou
24. LNCS 12785, Learning and Collaboration Technologies: Games and Virtual Environments for Learning (Part II), edited by Panayiotis Zaphiris and Andri Ioannou
25. LNCS 12786, Human Aspects of IT for the Aged Population: Technology Design and Acceptance (Part I), edited by Qin Gao and Jia Zhou
26. LNCS 12787, Human Aspects of IT for the Aged Population: Supporting Everyday Life Activities (Part II), edited by Qin Gao and Jia Zhou
27. LNCS 12788, HCI for Cybersecurity, Privacy and Trust, edited by Abbas Moallem
28. LNCS 12789, HCI in Games: Experience Design and Game Mechanics (Part I), edited by Xiaowen Fang
29. LNCS 12790, HCI in Games: Serious and Immersive Games (Part II), edited by Xiaowen Fang
30. LNCS 12791, HCI in Mobility, Transport and Automotive Systems, edited by Heidi Krömker
31. LNCS 12792, Adaptive Instructional Systems: Design and Evaluation (Part I), edited by Robert A. Sottilare and Jessica Schwarz
32. LNCS 12793, Adaptive Instructional Systems: Adaptation Strategies and Methods (Part II), edited by Robert A. Sottilare and Jessica Schwarz
33. LNCS 12794, Culture and Computing: Interactive Cultural Heritage and Arts (Part I), edited by Matthias Rauterberg
34. LNCS 12795, Culture and Computing: Design Thinking and Cultural Computing (Part II), edited by Matthias Rauterberg
35. LNCS 12796, Design, Operation and Evaluation of Mobile Communications, edited by Gavriel Salvendy and June Wei
36. LNAI 12797, Artificial Intelligence in HCI, edited by Helmut Degen and Stavroula Ntoa
37. CCIS 1419, HCI International 2021 Posters - Part I, edited by Constantine Stephanidis, Margherita Antona, and Stavroula Ntoa

38. CCIS 1420, HCI International 2021 Posters - Part II, edited by Constantine Stephanidis, Margherita Antona, and Stavroula Ntoa
39. CCIS 1421, HCI International 2021 Posters - Part III, edited by Constantine Stephanidis, Margherita Antona, and Stavroula Ntoa

http://2021.hci.international/proceedings

15th International Conference on Augmented Cognition (AC 2021)

Program Board Chairs: **Dylan D. Schmorrow,** ***Soar Technology Inc., USA*****, and Cali M. Fidopiastis,** ***Design Interactive, Inc., USA***

- Mehmet Emin Aksoy, Turkey
- Mark Costa, USA
- Martha Crosby, USA
- Fausto De Carvalho, Portugal
- Daniel Dolgin, USA
- Rodolphe Gentili, USA
- Ricardo Gregorio Lugo, Norway
- Monte Hancock, USA
- Robert Hubal, USA
- Kurtulus Izzetoglu, USA
- Benjamin Knox, Norway
- Chang Nam, USA
- Sarah Ostadabbas, USA
- Mannes Poel, Netherlands
- Dale Richards, UK
- Stefan Sütterlin, Norway
- Suraj Sood, USA
- Ayoung Suh, South Korea
- Ana Rita Teixeira, Portugal
- Martin Westhoven, Germany
- Ren Xu, Austria

The full list with the Program Board Chairs and the members of the Program Boards of all thematic areas and affiliated conferences is available online at:

http://www.hci.international/board-members-2021.php

HCI International 2022

The 24th International Conference on Human-Computer Interaction, HCI International 2022, will be held jointly with the affiliated conferences at the Gothia Towers Hotel and Swedish Exhibition & Congress Centre, Gothenburg, Sweden, June 26 – July 1, 2022. It will cover a broad spectrum of themes related to Human-Computer Interaction, including theoretical issues, methods, tools, processes, and case studies in HCI design, as well as novel interaction techniques, interfaces, and applications. The proceedings will be published by Springer. More information will be available on the conference website: http://2022.hci.international/:

General Chair
Prof. Constantine Stephanidis
University of Crete and ICS-FORTH
Heraklion, Crete, Greece
Email: general_chair@hcii2022.org

http://2022.hci.international/

Contents

BCI and Brain Activity Measurement

Distributed Remote EEG Data Collection for NeuroIS Research: A Methodological Framework . . . 3
Théophile Demazure, Alexander J. Karran, Jared Boasen, Pierre-Majorique Léger, and Sylvain Sénécal

Neurochat: Artistic Affective State Facial Filters in Online Video Communication . . . 23
Sarah Garcia and Marvin Andujar

A New Methodology to Learn Loops: Validation through Brain Computer Interaction . . . 33
Anabela Gomes, Ana Rita Teixeira, and António José Mendes

Individual Differences in fNIRS Measures of Cognitive Workload During a UAS Mission . . . 49
Jaime Kerr, Cooper Molloy, Pratusha Reddy, Patricia A. Shewokis, and Kurtulus Izzetoglu

Brain Activity Changes Elicited Through Multi-session Training Assessment in the Prefrontal Cortex by fNIRS . . . 63
Pratusha Reddy, Jaime Kerr, Patricia A. Shewokis, and Kurtulus Izzetoglu

Using Brain Computer Interaction to Evaluate Problem Solving Abilities . . . 74
Ana Rita Teixeira, Igor Rodrigues, Anabela Gomes, Pedro Abreu, and Germán Rodríguez-Bermúdez

Analysis of Effect of RSVP Speller BCI Paradigm Along with CNN to Analysis P300 Signals . . . 84
M. Uma, S. Prabhu, Murali Subramaniyam, and Seung Nam Min

A Literature Review on a Neuro-Psychological Approach to Immersive Technology Research . . . 97
Guan Wang and Ayoung Suh

Physiological Measuring and Human Performance

Cognitive Workload Quantified by Physiological Sensors in Realistic Immersive Settings . . . 119
Ashley Bishop, Emma MacNeil, and Kurtulus Izzetoglu

Pressure Analysis in Dynamic Handwriting for Forgery Detection 134
Mariam Doliashvili, Dwayne Jeffrey, Michael-Brian C. Ogawa, and Martha E. Crosby

Goal Orientation in Human Computer Interaction Tasks: An Experimental Investigation of User Engagement and Interaction Modalities 147
Mehmetcan Fal and Cengiz Acartürk

Repurposing the Quality Adjusted Life Year: Inferring and Navigating Wellness Cliques from High Sample Rate Multi-factor QALY 158
Monte Hancock, Ben Bowles, Robert Hanlon, and Joshua Wiser

Comparison Study of Attention Between Training in a Simulator vs. Live-Fire Range 178
Gregory P. Krätzig, Chet C. Hembroff, and Billea Ahlgrim

Passphrase Authentication and Individual Physiological Differences 198
Lila A. Loos, Randall K. Minas, Michael-Brian C. Ogawa, and Martha E. Crosby

Visual Hierarchy and Communication Effectiveness in Medical Decision Tools for Surrogate-Decision-Makers of Critically Ill Traumatic Brain Injury Patients 210
Javad Norouzi Nia, Fatima Varzgani, Soussan Djamasbi, Bengisu Tulu, Christopher Lee, and Susanne Muehlschlegel

Stepwise Evaluation Methodology for Smart Watch Sensor Function and Usability 221
Blaine Reeder, Malaika Gallimore, Chelsea Howland, Chuka Emezue, Katrina Boles, Allison Anbari, and Jo-Ana D. Chase

Modelling Human Cognition

Kantian Computational Linguistics 237
Karina Ionkina, Suraj Sood, Monte Hancock, Charlotte Walker, and Raman Kannan

Exploring Relationship Between Driver's Behavior and Cognitive Measures Observed by fNIRS in a Driving Simulator 250
Meltem Izzetoglu and Seri Park

Automatic Engagement Recognition for Distance Learning Systems: A Literature Study of Engagement Datasets and Methods 264
Shofiyati Nur Karimah and Shinobu Hasegawa

The Impact of Auditory Based Immersive Virtual Travel Experience on Mental Health of the Visually Impaired 277
Linghong Li

New Methods for Metastimuli: Architecture, Embeddings, and Neural Network Optimization 288
Rico A. R. Picone, Dane Webb, Finbarr Obierefu, and Jotham Lentz

Holarchic HCI and Augmented Psychology ("AugPsy"). 305
Suraj Sood

Augmented Cognition in Complex Environments

Human Characteristics and Genomic Factors as Behavioural Aspects for Cybersecurity 333
Laima Ambrozaitytė, Agnė Brilingaitė, Linas Bukauskas, Ingrida Domarkienė, and Tautvydas Rančelis

A Supervisor Agent-Based on the Markovian Decision Process Framework to Optimize the Behavior of a Highly Automated System. 351
A. Castellano, M. Karimshoushtari, C. Novara, and F. Tango

The Cognitive Study of Immersive Experience in Science and Art Exhibition 369
Ching-Wen Chang

Evaluation of a Virtual Reality Simulation Tool for Studying Bias in Police-Civilian Interactions 388
Long Doan, Rashawn Ray, Connor Powelson, Genesis Fuentes, Rebecca Shankman, Shaun Genter, and Jasmón Bailey

Utilizing Current Technologies to Foster Augmented On-line Learning 400
T. Liam Herman, Michael-Brian C. Ogawa, and Martha E. Crosby

Configurable Parallel Induction Machines. 407
Karina Ionkina, Monte Hancock, and Raman Kannan

Digital Human in Cybersecurity Risk Assessment 418
Aistė Jurevičienė, Agnė Brilingaitė, and Linas Bukauskas

Initial Reflections on the Use of Augmented Cognition in Derailing the Kill Chain. 433
Geir M. Køien

Location-Based Augmented Reality Games Through Immersive Experiences 452
Chutisant Kerdvibulvech

Selecting and Training Young Cyber Talent: A European Cybersecurity Challenge Case Study 462
Muahmmad Mudassar Yamin, Basel Katt, and Espen Torseth

Author Index 485