

Intelligent Systems Reference Library 196

Anthony Lewis Brooks · Sheryl Brahman ·
Bill Kapralos · Amy Nakajima ·
Jane Tyerman · Lakhmi C. Jain *Editors*

Recent Advances in Technologies for Inclusive Well-Being

Virtual Patients, Gamification and
Simulation

 Springer

Intelligent Systems Reference Library

Volume 196

Series Editors

Janusz Kacprzyk, Polish Academy of Sciences, Warsaw, Poland

Lakhmi C. Jain, KES International, Shoreham-by-Sea, UK

The aim of this series is to publish a Reference Library, including novel advances and developments in all aspects of Intelligent Systems in an easily accessible and well structured form. The series includes reference works, handbooks, compendia, textbooks, well-structured monographs, dictionaries, and encyclopedias. It contains well integrated knowledge and current information in the field of Intelligent Systems. The series covers the theory, applications, and design methods of Intelligent Systems. Virtually all disciplines such as engineering, computer science, avionics, business, e-commerce, environment, healthcare, physics and life science are included. The list of topics spans all the areas of modern intelligent systems such as: Ambient intelligence, Computational intelligence, Social intelligence, Computational neuroscience, Artificial life, Virtual society, Cognitive systems, DNA and immunity-based systems, e-Learning and teaching, Human-centred computing and Machine ethics, Intelligent control, Intelligent data analysis, Knowledge-based paradigms, Knowledge management, Intelligent agents, Intelligent decision making, Intelligent network security, Interactive entertainment, Learning paradigms, Recommender systems, Robotics and Mechatronics including human-machine teaming, Self-organizing and adaptive systems, Soft computing including Neural systems, Fuzzy systems, Evolutionary computing and the Fusion of these paradigms, Perception and Vision, Web intelligence and Multimedia.

Indexed by SCOPUS, DBLP, zbMATH, SCImago.

All books published in the series are submitted for consideration in Web of Science.

More information about this series at <http://www.springer.com/series/8578>

Anthony Lewis Brooks · Sheryl Brahman ·
Bill Kapralos · Amy Nakajima ·
Jane Tyerman · Lakhmi C. Jain
Editors

Recent Advances in Technologies for Inclusive Well-Being

Virtual Patients, Gamification and Simulation

 Springer

Editors

Anthony Lewis Brooks
Aalborg University
Esbjerg, Denmark

Bill Kapralos
maxSIMhealth
Ontario Tech University
Oshawa, ON, Canada

Jane Tyerman
Trent/Fleming School of Nursing
Trent University
Peterborough, ON, Canada

Sheryl Brahman
Computer Information Systems
Missouri State University
Spring Filed, MO, USA

Amy Nakajima
SIM Advancement & Innovation
Simulation Canada
Toronto, ON, Canada

Lakhmi C. Jain
KES International
Shoreham-by-Sea, UK

University of Technology Sydney
Sydney, Australia

ISSN 1868-4394 ISSN 1868-4408 (electronic)
Intelligent Systems Reference Library
ISBN 978-3-030-59607-1 ISBN 978-3-030-59608-8 (eBook)
<https://doi.org/10.1007/978-3-030-59608-8>

© 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

Preface

As co-editors, we welcome you as readers of this volume, in anticipation that you will enjoy the contents and hopefully inform other potential readers of the scope of knowledge across fields associated to ‘Technologies for Inclusive Well-Being’ that are offered herein.

We, the co-editors, are located at different corners of the globe, from Canada, Australia, UK, USA, and even little Denmark—*now waving the flag for the European Union contribution after Brexit!* While we work in different specific disciplines and industries, we have a common ground in being involved in education, research, and practices associated with health care and technologies targeting human ‘Well-Being’. Thus, aligned, we believe a richness of knowledge differences alongside motivational inspirations reside within the works presented in (and between) the pages you have in front of you that we anticipate can inform and inspire, stimulate and even surprise—and we are together, proud to be a part of producing this contribution to the field.

This book on ‘Technologies for Inclusive Well-Being’ follows on from associated publications, i.e. the 2014 [1] and 2017 [2] volumes, also edited by members of our current editing team. The decision to edit another volume came about through amassed positive responses attributed to the earlier publications as indicated by the near 30,000 downloads at the time of writing (Spring 2020), and we anticipate similar numbers of this volume. Inclusive well-being would seem a hot and growing topic. Associated technologies to well-being continue to advance alongside adoptions in applied practices; as reflected by international conferences around the world, it was clear the demand to expand should include topics as per title herein. In line with this, in this edition, the co-editors team has grown to six, and we are pleased to welcome Dr. Jane Tyerman and Dr. Amy Nakajima, both from Ottawa, Canada (please see the ‘About the Editors’ material for more details).

This Preface follows the 2017 volume in being titled *Recent Advances in Technologies for Inclusive Well-Being*. The 2020 sub-title informs on wider subjects of virtual patients, gamification, modelling, and simulation, thus building upon the earlier foci of ‘Wearables, Virtual Interactive Spaces (VIS)/Virtual Reality, Authoring tools, and Games (Serious/Gamification)’ in the 2017 volume that, in

turn, built upon the 2014 foci of Serious Games, Alternative Realities, and Play Therapy.

The vision behind realising incremental volumes was to ongoingly achieve a meaningful contribution for wide readerships across scholars and students; practitioners, administrators, and leaders; across industries and disciplines associated with digital wellness aligned to the evolution in health industry [3]. In achieving such publications, it is acknowledged how it would not have been possible without those authors whose contributions have been shared to the best of our abilities as editors. This, of course, means that behind the scenes, there are many people involved beyond those mentioned herein—from Springer staff who have supported and made tangible this and the other volumes, to the numerous international scholar peer reviewers who gave time to read, reflect, and critique submissions over a long period offering their wise comments to support optimising each text.

This publication covers wide ground, as introduced in the first chapter. Authors covering a gamut of disciplines come together under the inclusive well-being theme, and it is anticipated that there is something for everyone, be they academics, students, or an otherwise interested party. The main aim of the book is to disseminate this growing field through a combined effort to inform, educate, evoke—or even provoke, at least in thought—responses and discussions. While not the sole purpose, the editors, along with the authors, believe it important to bring such work presented out from behind the walls of establishments into the public sphere, so as to impact from a societal level.

The challenge of bringing together a collection of seminal work relating to technology is that it is subject to encroachment—things move fast. We have been aware of this challenge and need to publish a contemporary volume within a schedule, considering the prerequisite for up-to-date(ness) of presented research. The initial timeline had to be extended due to counterbalancing to the editors' different time zones, work and family commitments, and busy lives and distractions of the real world—for this delay, we apologise to authors. However, in stating this, we believe that the extension has resulted in an even stronger contribution, realised in a form to credit all involved.

Acknowledgements are given to all authors for their submitted works and patience and understanding in the editorial team's challenges to realise what is anticipated to be an impactful volume. We thank Springer's publishing team for their input to realise the volume. The editors thank their own families whose tolerance in supporting us in tackling such endeavours to publish is often tested; we are indebted for their support. The last acknowledgement is given to you, the reader, whom we thank for coming onboard from your specific individual perspective; in thanking you for the interest in the work, we anticipate your curiosity being stimulated by individual texts so as to read, not only chapters labelled in line with your position but also to stray and explore chapters not aligned to your discipline. In line with this latter statement, we offer no suggestions about how to read the book.

It is apt to mention at this time that this volume took longer than expected because of various delaying issues beyond our control, and accordingly, we apologise to the early submitting authors who have been patient in their wait to see the

realised publication. Also, the final stages of the volume completion happened at an unprecedented time in the world—after devastating fires in the Australian region, a wider invisible global threat to life and daily activities as we knew it rose out of China in the form of the COVID-19 pandemic. The authors of the contents of this volume mostly contributed prior to the pandemic. Few, upon hearing of the initial incursions in Asia, could have forecast its rampant impact that has devastated societies, communities, and families across nations globally, with much loss of life, traumatic experiences, and irreparable damage to infrastructures and economies. Our hearts and thoughts go out to those affected in whatever situation they find themselves, and we wish the very best to all. Many people at this time are comparing, wonderingly, their life before the onset of COVID-19, and their life as lived experience during this pandemic, and they are asking themselves and others what the world will be like, following the cessations of restrictions after effective vaccines and medicines are invented as they must be. The future is in balance as latest news channels suggest the coming of a second wave, as deaths and cases again rise in some countries. Trepidation and anxiety are pervasive, as healthcare workers and those caring for the aged—doctors, nurses, carers, staff, and all others involved—engage daily at the front-line, battling on behalf of the human race and each individual affected. These heroes should never be forgotten! We extend our thanks to all who are involved in Well-Being issues in this regard and alongside others. Humbly, the co-editors ask: What will human Well-Being entail following the pandemic? How will future societies govern for Well-Being? In what form will future ‘Advances in Technologies for Inclusive Well-Being’ take? ... and more. For now, we pray that to minimise impact, we all respect physical distancing, as advised by experts, we all maintain the highest level of hygiene, and if any signs are suspected, to self-quarantine. In so doing, we all give respect and love and support to others through this challenge for humankind. And ... future generations ahead, there should be stories passed down of the heroes in health services worldwide that battled through this pandemic and continue to fight saving lives and caring for others. Their sacrifices should not be forgotten in how they promoted inclusive Well-Being in whatever form and shape that may have taken.

In finally closing we, the editors, extend our warmest regards and encourage you to explore the texts herein, whetting your appetite, and to then dive further into the body of work, and possibly being stimulated to even visit the earlier volume—enjoy!

From us all, we wish you optimal well-being, stay safe and keep healthy.

Esbjerg, Denmark
 Springfield, USA
 Oshawa, Canada
 Toronto, Canada
 Peterborough, Canada
 Sydney, Australia

Anthony Lewis Brooks
 Sheryl Brahman
 Bill Kapralos
 Amy Nakajima
 Jane Tyerman
 Lakhmi C. Jain

References

1. Brooks, A.L., Brahnam, S., Jain, L.C. (eds.): Technologies of Inclusive Well-Being: Serious Games, Alternative Realities, and Play Therapy. Studies in Computational Intelligence. Springer <https://www.springer.com/gp/book/9783642454318> (2014)
2. Brooks, A.L., Brahnam, S., Kapralos, B., Jain, L.C. (eds.): Recent Advances in Technologies for Inclusive Well-Being: From Worn to Off-body Sensing, Virtual Worlds, and Games for Serious Applications. Intelligent Systems Reference Library. Springer <https://www.springer.com/gp/book/9783319498775> (2017)
3. Health 5.0: the emergence of digital wellness. <https://medium.com/qut-cde/health-5-0-the-emergence-of-digital-wellness-b21fdff635b9>

Contents

1	Re – Reflecting on Recent Advances in Technologies of Inclusive Well-Being	1
	Anthony Lewis Brooks	
1.1	Introduction	1
1.2	The Field	2
1.2.1	Editors and Concept Background in This Field	3
1.2.2	Current Volume	6
1.2.3	Contributions in This Book—See Table of Contents	7
1.2.4	Technology Adoption for Well-Being Intervention	7
1.2.5	Future Advancements	9
	References	13
 Part I Gaming, VR, and Immersive Technologies for Education/Training		
2	Gaming, VR, and Immersive Technologies for Education/Training	17
	Anthony Lewis Brooks	
2.1	Introduction	17
2.1.1	Experiential Training of Hand Hygiene Using Virtual Reality [1]	19
2.1.2	Useful, Usable and Used? Challenges and Opportunities for Virtual Reality Surgical Trainers [7]	20
2.1.3	Four-Component Instructional Design Applied to a Game for Emergency Medicine [8].	21
2.1.4	Enhanced Reality for Healthcare Simulation [15]	22

2.1.5	MaxSIMhealth: An Interconnected Collective of Manufacturing, Design, and Simulation Labs to Advance Medical Simulation Training [16]	23
2.1.6	Serious Games and Multiple Intelligences for Customized Learning: A Discussion [17].	24
2.1.7	Mobile Application for Convulsive and Automated External Defibrillator Practices [19].	25
2.1.8	Lessons Learned from Building a Virtual Patient Platform [21]	25
2.2	Conclusions	27
	References	28
3	Experiential Training of Hand Hygiene Using Virtual Reality	31
	Lauren Clack, Christian Hirt, Andreas Kunz, and Hugo Sax	
3.1	Introduction	32
3.2	Hand Hygiene—Related Work.	33
3.3	Virtual Reality for Experiential Training.	34
3.3.1	Experiential Learning Theory	34
3.4	Summary and Future Work	39
	References	40
4	Useful, Usable and Used?	43
	Chantal M. J. Trudel	
4.1	Introduction	43
4.1.1	Improving Healthcare Delivery, Patient Outcomes and Training Opportunities	44
4.2	Design Drivers in Developing VR Surgical Trainers	46
4.2.1	Is It Useful, Usable and Used?	46
4.2.2	Establishing System Requirements	48
4.2.3	Factors Influencing Usefulness, Usability and Use	48
4.3	Conclusion	59
	References	60
5	Four-Component Instructional Design Applied to a Game for Emergency Medicine	65
	Tjitske J. E. Faber, Mary E. W. Dankbaar, and Jeroen J. G. van Merriënboer	
5.1	Background and Significance	65
5.2	Game-Based Learning and Four-Component Instructional Design	68
5.2.1	Learning in a Game Environment	68
5.2.2	Four Component Instructional Design	68

- 5.2.3 4C/ID in Educational Games 71
- 5.2.4 4C/ID in Medical Education 72
- 5.3 Redesigning a Game for Emergency Care Using 4C/ID 73
 - 5.3.1 Learning Tasks and Task Classes 73
 - 5.3.2 Support and Guidance 73
 - 5.3.3 Supportive Information 75
 - 5.3.4 Procedural Information 75
 - 5.3.5 Part-Task Practice 76
 - 5.3.6 Design Process and Challenges 76
 - 5.3.7 Plans for Evaluation 79
- 5.4 Discussion and Lessons Learned 79
- 5.5 Conclusion 80
- References 81
- 6 A Review of Virtual Reality-Based Eye Examination 83**
 - Simulators 83**
 - Michael Chan, Alvaro Uribe-Quevedo, Bill Kapralos, Michael Jenkin,
Kamen Kanev, and Norman Jaimes
 - 6.1 Introduction 84
 - 6.2 Ophthalmoscopy Examination 86
 - 6.2.1 The Ophthalmoscope and Eye Fundus
Examination 86
 - 6.2.2 Ophthalmoscope Alternatives 87
 - 6.3 Simulation and Medical Education 88
 - 6.3.1 Standardised Patients 89
 - 6.3.2 Computer-Based Simulation 90
 - 6.3.3 Virtual/Augmented/Mixed Reality 90
 - 6.3.4 Simulation in Ophthalmology 91
 - 6.4 Direct Ophthalmoscopy Simulators 91
 - 6.5 Discussion 99
 - References 100
- 7 Enhanced Reality for Healthcare Simulation 103**
 - Fernando Salvetti, Roxane Gardner, Rebecca D. Minehart,
and Barbara Bertagni
 - 7.1 Enhanced Reality 104
 - 7.2 Enhanced Hybrid Simulation in a Mixed Reality Setting,
Both Face-to-Face and in Telepresence 105
 - 7.3 e-REAL as a CAVE-Like Environment Enhanced
by Augmented Reality and Interaction Tools 111
 - 7.4 The Simulation’s Phases Enhanced by e-REAL
and the Main Tools Made Available by the System 114
 - 7.5 Visual Storytelling and Contextual Intelligence, Cognitive
Aids, Apps and Tools to Enhance the Education Process
in a Simulation Lab or In Situ 122

7.6 The Epistemological Pillars Supporting e-REAL 127

7.7 Case-Study: Teamwork and Crisis Resource Management
for Labor and Delivery Clinicians 128

7.8 Conclusion 133

References 136

**8 maxSIMhealth: An Interconnected Collective of Manufacturing,
Design, and Simulation Labs to Advance Medical Simulation
Training 141**

maxSIMhealth Group

8.1 Introduction 141

8.1.1 Immersive Technologies 143

8.2 maxSIMhealth Projects 144

8.2.1 Immersive Technology-Based Solutions 144

8.2.2 Gamification- (and Serious Gaming-) Based
Solutions 158

8.2.3 The Gamified Educational Network (GEN) 158

8.2.4 3D Printing-Based Solutions 164

8.3 Discussion 169

8.4 Conclusions 171

References 171

**9 Serious Games and Multiple Intelligences for Customized
Learning: A Discussion 177**

Enilda Zea, Marco Valez-Balderas, and Alvaro Uribe-Quevedo

9.1 Introduction 177

9.2 Multiple Intelligences 179

9.3 Challenges to Educators 180

9.4 Technology Opportunities 181

9.5 Serious Games 182

9.6 Conclusion 184

References 186

**10 A Virtual Patient Mobile Application for Convulsive
and Automated External Defibrillator Practices 191**

Engie Ruge Vera, Mario Vargas Orjuela, Alvaro Uribe-Quevedo,
Byron Perez-Gutierrez, and Norman Jaimes

10.1 Introduction 192

10.2 Background Review 193

10.2.1 Early Simulation 194

10.2.2 Modern Simulation 195

10.3 Mobile Application Development 196

10.3.1 Automatic External Defibrillation 196

10.3.2 Convulsive Treatment 197

- 10.3.3 Design and Development 198
- 10.3.4 Game/Learning Mechanics 200
- 10.4 Preliminary Study 202
 - 10.4.1 Participants 203
 - 10.4.2 Pre and Post-test 204
 - 10.4.3 System Usability Scale 205
 - 10.4.4 Game Engagement Questionnaire 205
- 10.5 Conclusion 206
- References 207
- 11 Lessons Learned from Building a Virtual Patient Platform 211**
 - Olivia Monton, Allister Smith, and Amy Nakajima
 - 11.1 Introduction: Simulation and Virtual Patients 212
 - 11.2 Virtual Patient Platform Requirements 214
 - 11.3 Obstacles and Challenges 216
 - 11.4 Lessons Learned 218
 - 11.5 A Way Forward 218
 - References 219
- 12 Engaging Learners in Presimulation Preparation Through Virtual Simulation Games 223**
 - Marian Luctkar-Flude, Jane Tyerman, Lily Chumbley, Laurie Peachey, Michelle Lalonde, and Deborah Tregunno
 - 12.1 Background 225
 - 12.1.1 Presimulation Preparation 225
 - 12.1.2 Virtual Simulations 226
 - 12.1.3 Virtual Simulation Games 227
 - 12.1.4 Presimulation Preparation Using Virtual Simulation Games 229
 - 12.2 Virtual Simulation Game Project 230
 - 12.2.1 Rationale 230
 - 12.2.2 Objective 230
 - 12.2.3 Methods 230
 - 12.2.4 Scenario Selection 231
 - 12.2.5 Description of the Innovation 231
 - 12.2.6 Usability Testing 231
 - 12.2.7 Cost Utility and Learning Outcomes 232
 - 12.3 Results 232
 - 12.4 Discussion 233
 - 12.4.1 Strengths and Limitations 233
 - 12.5 Conclusions 234
 - References 235

Part II VR/Technologies for Rehabilitation

13 VR/Technologies for Rehabilitation 241
Anthony Lewis Brooks
13.1 Introduction 241
13.1.1 Game-Based (Re)habilitation via Movement Tracking [2] 242
13.1.2 Case Studies of Users with Neurodevelopmental Disabilities: Showcasing Their Roles in Early Stages of VR Training Development [3] 244
13.1.3 AquAbilitation: ‘Virtual Interactive Space’ (VIS) with Buoyancy Therapeutic Movement Training [4] 246
13.1.4 Interactive Multisensory VibroAcoustic Therapeutic Intervention (iMVATi) [5] 249
13.2 Conclusions 251
References 251
14 Game-Based (Re)Habilitation via Movement Tracking 253
Anthony Lewis Brooks and Eva Brooks
14.1 Introduction 253
14.1.1 Presence and Aesthetic Resonance: As a ‘Sense State’ Continuum 254
14.1.2 Play 255
14.1.3 Under Used Resource for Therapy 255
14.2 Gameplaying and Mastery 256
14.3 Method 257
14.3.1 Description of Material 258
14.3.2 Description of Procedure 258
14.3.3 Description of the Set up 259
14.3.4 Description of Analysis 259
14.4 Results 262
14.4.1 Tempo Spatial Movements 262
14.4.2 Interface and Activities 263
14.4.3 Resource for Therapy 264
14.5 Discussion 265
14.6 Conclusions 266
Appendix 1 267
Appendix 2 267
Appendix 3 268
Appendix 4 269
References 273

15 Case Studies of Users with Neurodevelopmental Disabilities: Showcasing Their Roles in Early Stages of VR Training Development 275
 Yurgos Politis, Nigel Newbutt, Nigel Robb, Bryan Boyle, Hung Jen Kuo, and Connie Sung

15.1 Introduction 276

15.2 Neurodiversity and Participatory Design 277

15.3 Ethical Considerations 279

15.4 Case Study Presentations 279

15.5 Case Study 1: Engaging Users in the Potential of Virtual Reality Opportunities for Learning in Schools 280

15.5.1 Brief Overview/introduction 280

15.5.2 Aims and Objectives 280

15.5.3 Context/Setting 282

15.5.4 Case Study Group/Characteristics 282

15.5.5 Findings 284

15.6 Case Study 2: Participatory Design Approach to Co-Create Training Materials on a Daily Living Task for Young Adults with Intellectual Disabilities 289

15.6.1 Brief Overview/introduction 289

15.6.2 Aims and Objectives 289

15.6.3 Context/Setting 290

15.6.4 Case Study Group/Characteristics 290

15.6.5 Findings 291

15.7 Overall Discussion and Conclusions 294

15.8 Implications for Practice and Further Work 296

References 297

16 AquAbilitation: ‘Virtual Interactive Space’ (VIS) with Buoyancy Therapeutic Movement Training 299
 Anthony Lewis Brooks

16.1 Preamble/Introduction 299

16.1.1 Simulation and Targeted End-Users/participants 300

16.1.2 PoC—Design Justification 301

16.1.3 Technology and End-Users 301

16.2 Technologies and Terminology: From Virtual Reality (VR) to Virtual Interactive Space (VIS) 302

16.3 Background and Concept—Fieldwork and Theoretical Framework 305

16.4 Fieldwork 308

16.5 Hydrotherapy (with Innate Multimedia-Driven Causal Cycles of Action-Interactions) 308

16.6 Aquatic and Virtual ‘Immersion’ (Pun Intended) 309

16.7 Set-Up of PoC 310

- 16.8 Software Examples for Non-Aquatic Movement
Tracking-Environments (Typically Dance) 310
- 16.9 Techniques—for Example with EyesWeb and EyeCon
Software 311
- 16.10 Lighting 313
- 16.11 Projected Image Versus HMD 313
- 16.12 Conclusions 315
- 16.13 Summary 316
- 16.14 Further Challenges, Critique, and Reflections Toward
Future Research 317
- 16.15 Closing Summary 320
- References 321

17 Interactive Multisensory VibroAcoustic Therapeutic Intervention (iMVATi) 325

Anthony Lewis Brooks

- 17.1 Introduction 325
- 17.2 Biofeedback 326
- 17.3 Multisensory Stimulus: Sound, Sound Therapy, Music
Therapy, Vibroacoustic Intervention 328
- 17.4 Soundbeam and Sound Therapy 329
- 17.5 Multisensory Stimulus: Visuals—Case Studies 1 and 2 332
- 17.6 Multisensory Stimulus: Tactile/Haptic = Vibroacoustic
Therapeutic Intervention 333
- 17.7 VIBRAC and Review of the Field 336
- 17.8 Conclusion 337
- 17.9 Future Research in Interactive Vibroacoustic Therapeutic
Intervention 337
- 17.10 Postscript 338
- Bibliography 339

Part III Health and Well-Being

18 Health and Well-Being 345

Anthony Lewis Brooks

- 18.1 Introduction 345
 - 18.1.1 Current Trends in Technology and Wellness
for People with Disabilities: An Analysis of Benefit
and Risk [1]. 346
 - 18.1.2 Electrorganic Technology for Inclusive Well-being
in Music Therapy [2] 346
 - 18.1.3 Interactive Multimedia: A Take on Traditional Day
of the Dead Altars [3] 348
 - 18.1.4 Implementing Co-design Practices for the
Development of a Museum Interface for Autistic
Children [4] 349

18.1.5	Combining Cinematic Virtual Reality and Sonic Interaction Design in Exposure Therapy for Children with Autism [10].	351
18.2	Conclusions	351
	References	352
19	Current Trends in Technology and Wellness for People with Disabilities: An Analysis of Benefit and Risk	353
	Hung Jen Kuo, Connie Sung, Nigel Newbutt, Yurgos Politis, and Nigel Robb	
19.1	Introduction: Technology as Daily Routine	354
19.2	Benefits	355
19.2.1	Technology for Mainstreaming Assistive Device	355
19.2.2	Technology for Education and Employment.	356
19.2.3	Technology for Service Delivery	357
19.2.4	Technology for Social Interaction and Recreation	357
19.3	Risk	360
19.3.1	Assistive Technology Being Abandoned	360
19.3.2	Technology as Ethical Concerns	361
19.3.3	Technology as Social Disincentive	363
19.4	Conclusion	365
	References	366
20	Electrorganic Technology for Inclusive Well-being in Music Therapy	373
	Anthony Lewis Brooks and Carl Boland	
20.1	Introduction and Background	373
20.2	Music and Music Therapy	374
20.3	Technology Empowered Musical Expression in Therapeutic Settings	375
20.4	Alternative Musical Instruments and the aFrame in Music Therapy	376
20.5	Musicality and Nuances of Expression	377
20.6	ATV Electrorganic aFrame	378
20.7	Adaptive Timbre Technology.	379
20.8	The Electrorganic aFrame in Use	382
20.9	European Music Therapy Conference (EMTC), Aalborg Denmark 2019 (See Brooks [3])	383
20.10	Proof of Concept and Feasibility Trials in Practice	385
20.10.1	Next Steps—A Speculation	387
20.11	Conclusion	388
	References	389

21 Interactive Multimedia: A Take on Traditional Day of the Dead Altars 391

Ramón Iván Barraza Castillo, Alejandra Lucía De la Torre Rodríguez, Rogelio Baquier Orozco, Gloria Olivia Rodríguez Garay, Silvia Husted Ramos, and Martha Patricia Álvarez Chávez

21.1 Introduction 392

21.2 Day of the Dead 393

21.3 Literature Review 394

 21.3.1 Technology-Enhanced Exhibitions 394

 21.3.2 Exhibitions, Interventions, and Mental Well-being 395

21.4 Method 396

 21.4.1 Traditional Altars 397

 21.4.2 Narrative Elements 399

 21.4.3 Interactivity and User Experience 401

 21.4.4 Altar Installation 405

21.5 Exhibition 412

21.6 Conclusion 416

References 417

22 Implementing Co-Design Practices for the Development of a Museum Interface for Autistic Children 421

Dimitra Magkafa, Nigel Newbutt, and Mark Palmer

22.1 Introduction 421

22.2 Literature Review 423

 22.2.1 The Emergence of Interactive Technologies for Children with Autism 423

 22.2.2 Research on Co-Design Technology for Autistic 424

22.3 Study Design 425

 22.3.1 Design and Development 426

 22.3.2 Stage 1 Discovery 428

 22.3.3 Stage 2 Concept Development 432

 22.3.4 Stage 3 User-Testing- Evaluating the Interface 434

 22.3.5 Stage 4 Re-Design the Platform 434

22.4 Discussion 435

 22.4.1 Engagement and children’s Input Based on Their Abilities 435

 22.4.2 Building Rapport 437

 22.4.3 Individuals 437

 22.4.4 Suitable Environments 438

 22.4.5 Creativity Potentials 438

 22.4.6 Teacher’s Involvement 439

22.5 Conclusion 440

References 441

23 Combining Cinematic Virtual Reality and Sonic Interaction
Design in Exposure Therapy for Children with Autism 445
 Lars Andersen, Nicklas Andersen, Ali Adjorlu, and Stefania Serafin

23.1 Introduction 445
 23.2 State of the Art 446
 23.3 Design 447
 23.3.1 Space 448
 23.3.2 Multiplayer 450
 23.4 Recording Session 451
 23.5 Evaluation 451
 23.5.1 Setup 451
 23.5.2 Target Group and Sampling 452
 23.5.3 Evaluating the Children 453
 23.5.4 Evaluating the Guardians 454
 23.5.5 Microsoft Desirability Toolkit 455
 23.6 Ethical Issues 456
 23.7 Conclusion 456
 References 457

Part IV Design and Development

24 Design and Development 461
 Anthony Lewis Brooks

24.1 Introduction 461
 24.1.1 Participatory Technology Design for Autism
 and Cognitive Disabilities: A Narrative Overview of
 Issues and Techniques [1] 462
 24.1.2 Exploring Current Board Games’ Accessibility
 Efforts for Persons with Visual Impairment [6] 463
 24.1.3 An Extensible Cloud-Based Avatar: Implementation
 and Evaluation [7] 464
 24.1.4 Frontiers of Immersive Gaming Technology:
 A Survey of Novel Game Interaction Design
 and Serious Games for Cognition [8] 464
 24.2 Conclusions 466
 References 466

**25 Participatory Technology Design for Autism and Cognitive
 Disabilities: A Narrative Overview of Issues and Techniques** 469
 Nigel Robb, Bryan Boyle, Yurgos Politis, Nigel Newbutt,
 Hung Jen Kuo, and Connie Sung

25.1 Introduction 470
 25.1.1 Participatory Design 470
 25.1.2 Participatory Design and Neurodevelopmental
 Disabilities 472

- 25.2 Transfer of Tacit Knowledge: Communicating the Lived Experience 473
- 25.3 Active Co-creation 474
- 25.4 Making Ideas Tangible: Prototyping 476
 - 25.4.1 Prototyping Techniques 477
- 25.5 Empowerment Through Decision-Making 479
- 25.6 The Importance of Setting 480
- 25.7 Use of Proxies 480
- 25.8 Ownership 481
- 25.9 Conclusion 481
- References 482

- 26 Exploring Current Board Games’ Accessibility Efforts for Persons with Visual Impairment 487**
 - Frederico Da Rocha Tomé Filho, Bill Kapralos, and Pejman Mirza-Babaei
 - 26.1 Introduction 487
 - 26.2 Selection Classification 490
 - 26.3 Accessible Digital Games 492
 - 26.4 Accessible Board Games: Community and Industry Efforts 494
 - 26.5 Game Accessibility Guidelines 495
 - 26.6 Immersive Technologies (VR and AR) and Related 496
 - 26.7 Conclusions 498
 - References 499

- 27 An Extensible Cloud Based Avatar: Implementation and Evaluation 503**
 - Enas Altarawneh, Michael Jenkin, and I. Scott MacKenzie
 - 27.1 Introduction 504
 - 27.2 Previous Work 504
 - 27.3 Building the Avatar 505
 - 27.3.1 Lip-Syncing Spoken Words 507
 - 27.3.2 Building a Realistic Utterance State Transition 508
 - 27.4 Rendering the Avatar 509
 - 27.4.1 Distributed Rendering in the Cloud 510
 - 27.5 User Study 511
 - 27.5.1 Method 512
 - 27.5.2 Results 515
 - 27.5.3 Discussion 519
 - References 521

Chapter 21

Interactive Multimedia: A Take on Traditional Day of the Dead Altars



Ramón Iván Barraza Castillo, Alejandra Lucía De la Torre Rodríguez, Rogelio Baquier Orozco, Gloria Olivia Rodríguez Garay, Silvia Husted Ramos, and Martha Patricia Álvarez Chávez

Abstract This chapter presents the creation of a traditional and technologically enhanced Mexican Day of the Dead altar. The authors offer a detailed view of the entire process, from the conception of the idea, identification and classification of narrative elements, construction of the offering based on an interactive multimedia user experience model, the inner workings as well as the construction, installation, and exhibition. The altar was presented and evaluated during a mass public event in the Mexican town of Juárez, during a celebration of the Day of the Dead. The idea behind this project is to enhance this century-old tradition with a non-invasive approach to technology to infuse a non-linear narrative experience that connects with the user and promotes spiritual well-being.

Keywords Day of the dead celebration · Arduino · Interactive multimedia · Non-linear narrative · User experience · User interface

R. I. Barraza Castillo · A. L. De la Torre Rodríguez (✉) · R. Baquier Orozco · G. O. Rodríguez Garay · S. Husted Ramos · M. P. Álvarez Chávez
Architecture, Design and Art Institute, Ciudad Juárez Autonomous University, Ciudad Juárez, Chihuahua, México
e-mail: lucia.delatorre@uacj.mx

R. I. Barraza Castillo
e-mail: ramon.barraza@uacj.mx

R. Baquier Orozco
e-mail: rogelio.baquier@uacj.mx

G. O. Rodríguez Garay
e-mail: grodriugu@uacj.mx

S. Husted Ramos
e-mail: shusted@uacj.mx

M. P. Álvarez Chávez
e-mail: malvarez@uacj.mx