

Enhanced Living Environments

From models to technologies

Edited by

Rossitza Ivanova Goleva, Ivan Ganchev, Ciprian Dobre,
Nuno Garcia and Carlos Valderrama



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Enhanced Living Environments

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Dedication

*To my family and friends.
In Memoriam to Rumen Stainov.*

– Rossitza Goleva

To all my family and extended family.

– Ivan Ganchev

*To Anamaria and Iulia, the two beautiful girls in my life,
with all my love.*

– Ciprian Dobre

*To the true team spirit of the AAPELE Team
and to my family and friends!*

– Nuno M. Garcia

*To the great AAPELE team that provides the essential energy
we all need as well as to our families who support our dedication
and sacrifices.*

– Carlos Valderrama

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Contents

About the editors	xv
Preface	xix
Acknowledgements	xxiii
1 Introduction to enhanced living environments	1
<i>Ciprian Dobre, Ivan Ganchev, Nuno M. Garcia, Rossitza Goleva and Carlos Alberto Valderrama</i>	
Abstract	1
1.1 Introduction	1
1.2 An overview of healthcare systems	3
1.3 Ambient assisted living and enhanced living environments	7
1.4 Conclusions	14
Acknowledgements	16
References	16
Biographies	18
2 Enhanced living environments from the viewpoint of socioecological psychology	21
<i>Tamás Martos and Viola Sallay</i>	
Abstract	21
2.1 Introduction	21
2.2 Socioecological psychology as a framework	22
2.3 Concept of ‘human niche construction’ as a universal human phenomenon	22
2.4 Home as a niche	24
2.4.1 Emotional processes in the home: lessons learnt with the Emotional Map of the Home Interview	25
2.5 Legacy of Self-determination theory	28
2.5.1 Core concepts of SDT	28
2.6 Putting it all together: socioecological psychological aspects of ELE	30
2.6.1 ELE as niche construction	31
2.6.2 ELE and home niches: the potential places of technology in a complex system	34
2.6.3 Constructing ELE solutions in home niches: the importance of psychological need support	36

2.7	Conclusions	40
	Acknowledgements	41
	References	41
	Further reading	46
	Biographies	47
3	Pervasive sensing for social connectedness	49
	<i>Kadian Davis, Evans B. Owusu, Lucio Marcenaro, Jun Hu, Carlo S. Regazzoni, and Loe Feijs</i>	
	Abstract	49
3.1	Introduction	49
3.1.1	Social isolation and loneliness as risk factors	50
3.1.2	Ambient assisted living	50
3.2	A user-centred approach for designing systems to support social connectedness	52
3.2.1	A user-centred design process	53
3.3	Context-aware systems for social connectedness	55
3.4	Pervasive sensing and models for HAR	57
3.5	A case study evaluating the HMM-SVM model	60
3.6	Context-aware connectedness systems	62
3.7	Experimental results	65
3.7.1	Perceptions on context-aware solutions for social connectedness	65
3.7.2	HAR-based activity displays for social connectedness	66
3.8	Challenges	69
3.9	Conclusion	69
	Acknowledgements	70
	References	70
	Further reading	77
	Data set	77
	Biographies	77
4	Ethics in information and communication technologies: training the elderly in making gerontechnology accessible	81
	<i>Hélène Geurts, Marie-Claire Haelewyck, and Carlos Valderrama</i>	
	Abstract	81
4.1	Introduction	81
4.2	Generation effect	82
4.3	Gerontechnology is a neologism vector of the future	83
4.4	Pitfalls to be avoided	85
4.5	Ethical issues at stake	88
4.6	Identification of needs, the keystone of reflection	90
4.7	Need for acceptability, the secret of success	93
4.8	Conclusion	95
	Acknowledgements	95

References	95
Further reading	98
Biographies	99
5 End-users' AAL and ELE service scenarios in smart personal environments	101
<i>Serge Autexier, Rossitza Goleva, Nuno M. Garcia, Rumen Stainov, Ivan Ganchev, Constandinos X. Mavromoustakis, Ciprian Dobre, Ivan Chorbev, Vladimir Trajkovik, and Eftim Zdravevski</i>	
Abstract	101
5.1 Introduction	102
5.2 State of the art	103
5.3 Living lab architecture	106
5.4 End-user groups	108
5.5 From single user and single sensor to the cloud and back	110
5.6 Scenarios	114
5.7 Customized ELE ICT services	120
5.8 Conclusions and further research directions	122
Acknowledgements	122
References	122
Further reading	128
Biographies	128
6 Technological support to stress-level monitoring	133
<i>Valentina Markova and Todor Ganchev</i>	
Abstract	133
6.1 Introduction	133
6.2 State-of-the-art personal health monitoring systems	135
6.2.1 Physiological parameters and stress	135
6.2.2 Overview of system architectures	139
6.2.3 Short-range wireless network technology	141
6.3 Stress and emotion assessment	145
6.3.1 Stress assessment procedure	146
6.3.2 Emotion recognition	147
6.4 Use cases	148
6.4.1 Stationary setup	148
6.4.2 Mobile setup	149
6.4.3 Recent projects	151
6.4.4 SLADE application scenario	152
6.5 Future technology in support of stress monitoring and management	153
References	155
Further reading	158
List of abbreviations	159
Biographies	160

7	Big data healthcare system to improve healthcare information searching in the Internet	161
	<i>Mariya Savova Evtimova</i>	
	Abstract	161
	7.1 Introduction	161
	7.2 Intelligent agents' advantages and characteristics	162
	7.3 Fuzzy logic and probability	163
	7.4 Meaning of big data in a personalized search of uncertain and vague information	165
	7.4.1 Value and demand in-depth analysis	165
	7.4.2 Variety and heterogeneity of data	165
	7.4.3 Quality of data	166
	7.4.4 Volume and size of data	166
	7.4.5 Speed and timeliness of the data	166
	7.5 Rule-based and case-based reasoning	166
	7.6 Related work	167
	7.7 Agent-based system for personalized searching	167
	7.7.1 Aims and tasks of the developed system	168
	7.7.2 Conceptual model for personalized semantic search system when the information in the query is fuzzy and uncertain	168
	7.8 Concept of building a customized profile	172
	7.8.1 Approaches and methods for collecting user information	172
	7.8.2 Conceptual scheme of the user profile	173
	7.9 Development of applied subjective ontology: problems and approaches	174
	7.9.1 Storing the knowledge in the fuzzy ontology of the proposed semantic system	174
	7.9.2 Fuzzification process in case-based ontology	174
	7.9.3 Design of the fuzzy and vague case-based ontology	174
	7.10 Description of the process of reasoning	175
	7.11 Metrics for evaluating the quality of the returned results from the search system	178
	7.12 Conclusions	178
	References	180
	Further reading	182
	List of abbreviations	182
	Biography	182
8	Sensors for wireless body area networks	183
	<i>Ivelina Nikolaeva Ruskova and Elitsa Emilova Gieva</i>	
	Abstract	183

8.1	Introduction: wireless body area networks and wireless sensor network	183
8.2	Sensor node	184
8.3	Overview of sensor characteristics	192
8.4	WBAN technologies	199
8.4.1	Applications depending on the technology	200
8.5	Conclusion	202
	References	202
	Further reading	204
	Biographies	204
9	AALaaS/ELEaaS platforms	207
	<i>Rossitza Goleva, Mara Pudane, Sintija Petrovica, Egons Lavendelis, Karl Kreiner, Mario Drobits, Ivan Ganchev, Nuno M. Garcia, Rumen Stainov, Ciprian Dobre, Constandinos X. Mavromoustakis, Ivan Chorbev, Vladimir Trajkovik, Eftim Zdravevski, and George Mastorakis</i>	
	Abstract	207
9.1	Introduction	208
9.2	State of the art	209
9.3	Generic AALaaS/ELEaaS architecture	210
9.4	Affective computing mapping implementation	216
9.5	KIOLA platform implementation	220
9.6	AAL/ELE laboratory and home implementation	223
9.7	Conclusion and further research plan	224
	Acknowledgements	224
	References	224
	Further reading	229
	Biographies	229
10	Linear wireless sensor networks and protocols in the next-generation networks	235
	<i>Radosveta I. Sokullu and Eren Demir</i>	
	Abstract	235
10.1	Introduction	236
10.2	Linear wireless sensor networks	237
10.2.1	Network model	237
10.2.2	Variations of LWSNs	238
10.2.3	Objectives and challenges of LWSNs	240
10.3	MAC protocols for LWSNs	241
10.4	Open research issues	262
10.5	Conclusion	262
	References	263

Further reading	266
List of abbreviations	266
Glossary	267
Biographies	268
11 Model-compilation challenges for cyber-physical systems	269
<i>Belgacem Ben Hedia, Chokri Mraidha, Etienne Hamelin, and Sara Tucci-Piergiovanni</i>	
Abstract	269
11.1 Introduction	269
11.2 CPS challenges	272
11.3 Model-compilation methodology and approach	275
11.3.1 Front-end: from multiple heterogeneous high-level models	275
11.3.2 Middle-end: model-compilation into SwArch	280
11.3.3 Back-end: transformation into concrete target platforms	283
11.3.4 Design iterations	283
11.4 Model-compilation methodology assessment	284
11.4.1 Applicability of model-compilation approach	284
11.4.2 Productivity enhancements	285
11.5 Related works	285
11.5.1 Model-based methodologies for safety and timing	285
11.5.2 Model-compilation	286
11.5.3 Physical modelling	287
11.6 Conclusion	288
References	288
Biographies	291
12 Health monitoring using WBAN: topology design, routing and thermal issues	293
<i>Ghufran Ahmed, Saif Ul Islam, Maham Shahid, Azfar Shakeel, Najmun Nisa, Najmul Hassan, Numera M.I. Shahid, Zaheer Ul Hussain Sani, and Hilal Jan</i>	
Abstract	293
12.1 Introduction	293
12.1.1 Applications	295
12.1.2 WBAN wireless technologies	298
12.1.3 WBAN infrastructure	300
12.1.4 Energy efficiency	300
12.1.5 Approaches to achieve energy efficiency	300
12.2 Energy-aware topology design	301
12.2.1 Optimization of relay nodes placement	304

12.3	SAR analysis	304
12.3.1	Using low transmission power level to reduce SAR	305
12.3.2	Impact of frequency band on SAR values	305
12.3.3	Impact of high SAR on human body	305
12.4	Energy efficient and SAR-aware routing	306
12.4.1	Energy-efficient routing	306
12.4.2	SAR-aware routing	308
12.5	Conclusion	309
	References	309
	Biographies	313
13	Wearable health care: technology evolution, algorithms and needs	315
	<i>Raluca Maria Aileni, Sever Pasca, Carlos Alberto Valderrama, and Rodica Strungaru</i>	
	Abstract	315
13.1	Introduction	315
13.2	Wearable technology evolution	316
13.3	Healthcare perspectives for wearable devices	324
13.4	Algorithms dedicated to wearable technologies	325
13.4.1	Case 1: wearable sensors for body temperature monitoring	326
13.4.2	Case 2: wearable sensors for human skin conductance response	331
13.4.3	Case 3: wearable sensors for human activity monitoring	332
13.5	Wearable: user needs and expectations	334
13.6	Future wearable challenges	335
13.7	Conclusions	337
	Acknowledgements	338
	References	338
	Biographies	342
14	Intelligent system for after-stroke home rehabilitation	345
	<i>Nirvana Popescu, Marian-Silviu Poboroniuc, Decebal Popescu, Dănuț Irimia, and Alexandru Valer Grigoraș</i>	
	Abstract	345
14.1	Introduction	345
14.2	Design and development of the IHRG structure	348
14.3	Voice control approach	349
14.3.1	Hardware and software design	349
14.3.2	Experiments with vocal commands	352
14.4	Predefined recovery exercises system for home use	353

14.5	Hybrid FES-robotic glove approach	354
14.5.1	Hybrid system description	354
14.5.2	Experimental results	358
14.5.3	Statistical analysis	360
14.6	Conclusion	364
	References	365
	Biographies	366

Index	369
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About the editors

Ciprian Dobre is Professor within the Computer Science Department, University Politehnica of Bucharest (Habil. since 2014, Dr. Since 2008 with Cum laudae). He currently leads the activities within Laboratory on Pervasive products and services, and MobyLab. Ciprian Dobre's research interests involve research subjects related to mobile wireless networks and computing applications, pervasive services, context awareness and people-centric or participatory sensing. He has scientific and scholarly contributions in the field of large-scale distributed systems concerning mobile applications and smart technologies to reduce urban congestion and air pollution (MobiWay, TRANSYS), context-aware applications (CAPIM), opportunistic networks and mobile data offloading (SPRINT, SENSE), monitoring (MonALISA), high-speed networking (VINCI, FDT), Grid application development (EGEE, SEE-GRID) and evaluation using modelling and simulation (MONARC 2, VNSim). These contributions led to important results, demonstrating his qualifications and potential to go significantly beyond the state of the art. Ciprian Dobre was awarded a PhD scholarship from California Institute of Technology (Caltech, USA), and another one from Oracle. His results received one IBM Faculty Award, two CENIC Awards and three Best Paper Awards (in 2013, 2012 and 2010). The results were published in over 100 chapters in edited books, articles in major international peer-reviewed journals and papers in well-established international conferences and workshops.

Dr. Ivan Ganchev is a Senior Member of the Institute of Electrical and Electronic Engineers (IEEE), the IEEE Communications Society, the IEEE Consumer Electronics Society, the IEEE Internet of Things Community, the IEEE Smart Cities Community and the IEEE Consultants Network. He received his doctoral and engineering (summa cum laude) degrees from the Saint-Petersburg State University of Telecommunications. He is a Deputy Director of the Telecommunications Research Centre (TRC), University of Limerick (Ireland), an Associate Professor from the University of Plovdiv "Paisii Hilendarski", an ITU-T Invited Expert and an IET Invited Lecturer. Dr. Ganchev was involved in 35+ international and national research and education projects. His research interests include novel telecommunications paradigms, future networks and services, smart ubiquitous networking, context-aware networking, mobile cloud computing, Internet of Things (IoT), Internet of Services (IoS), ambient assisted living (AAL), enhanced living environments (ELE), trust management, Internet tomography, mHealth and mLearning ICT. Dr Ganchev has served on the Technical Program Committee of

200+ prestigious international conferences, symposia and workshops. He has authored/co-authored 6 books (including 2 edited books) and 240+ research papers in refereed international journals and conference proceedings. Dr. Ganchev is on the editorial board of and has served as a Guest Editor for multiple international journals.

Nuno M. Garcia holds a Ph.D. in Computer Science Engineering from the University of Beira Interior (UBI, Covilhã, Portugal) (2008) and he is a 5-year B.Sc. (Hons.) in Mathematics/Informatics also from UBI (1999–2004). He is Assistant Professor at UBI and Invited Associate Professor at the School of Communication, Architecture, Arts and Information Technologies of the Universidade Lusófona de Humanidades e Tecnologias (Lisbon, Portugal). He was founder and is coordinator of the Assisted Living Computing and Telecommunications Laboratory (ALLab), a research group within the Instituto de Telecomunicações at UBI. He was also cofounder and is Coordinator of the Executive Council of the BSAFE LAB – Law enforcement, Justice and Public Safety Research and Technology Transfer Laboratory, a multidisciplinary research laboratory in UBI. He is the coordinator of the Cisco Academy at UBI, Head of EyeSeeLab in Eye- See Lda. (Lisbon, Portugal), and member of the Consultative Council of Favvus IT HR SA (Lisbon). He is also Chair of the COST Action IC1303 AAPELE – Architectures, Algorithms and Platforms for Enhanced Living Environments. He is the main author of several international, European and Portuguese patents. He is member of the Non-Commercial Users Constituency, a group within GNSO in ICANN. His main interests include next-generation networks, algorithms for bio-signal processing, distributed and cooperative protocols.

Rossitza Goleva received her Ph.D. in Communication Networks in 2016 and M.Sc. in Computer Science in 1982 at Technical University of Sofia, Bulgaria. She was part of the research staff of the research Institute of Bulgarian PTT between 1982 and 1987. Since 1987, she is with Department of Communication Networks at Technical University of Sofia. At present, Rossitza works on communication networks, communication protocols and software engineering. Her research interests are in Quality of Service in communication networks, communication protocols, traffic engineering, cloud and fog computing, performance analyses. She is an IEEE Member, involved in IEEE Bulgaria section activities, has more than 85 research publications, was part of more than 30 research projects including and EU COST IC1303 AAPELE action.

Carlos Alberto Valderrama is, since 2004, Director of the Electronics and Microelectronics Department at the Polytechnic Faculty of the University of Mons in Belgium. The Electronics and Microelectronics Department is member of the Numediart (New Media Art Technology) and the InforTec (Information Technology) Institutes. He obtained the Ph.D. degree in Microelectronics at the INPG in Grenoble, France, in 1998, the M.Sc. diploma at the Federal University of Rio de Janeiro (UFRJ-COPPE), Brazil, in 1993, and the electrical-electronics engineering

diploma at the National University of Cordoba (UNC), Argentina, in 1989. He was visiting professor at two Brazilian universities, at the Federal University of Pernambuco (UFPE) in 2004 and at the Federal University of Rio Grande do Norte (UFRN) in 1998. Between 1999 and 2004, he was leading the Hardware-Flow team in CoWare NV. (today acquired by Synopsys), Belgium. In 2009, he was responsible for the creation of the spinoff Nsilitation (<http://www.nsilition.com/>) resulting from the IPfundry project funded by the Walloon Region. His primary research interests include wireless communication, EDA and system level design of reconfigurable embedded architectures. He has participated in more than 15 national and international research projects from the development of 4G chips to next-generation tracking devices and software architectures for the IoT, satellite and multicore industry, collaborating with partners such as Alcatel, STMicroelectronics, NXP and Thales. He serves as technical reviewer and committee member of multiple journals and international conferences. His research activity is supported by more than 150 publications on international conferences, more than 10 books chapters, and more than 30 scientific journals. He is IEEE senior member since 2006.

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Preface

The implementation of the information and communication technologies (ICTs) in healthcare and caregiving areas, the increase in medical expenses, problems with demographic ageing, the dynamics of the everyday life and the necessity to take care of the family put a strong pressure on the sustainability of health and social care systems, on the labour participation and on the quality of life for elderly, people with disabilities, children and active people. Enhanced living environments (ELEs) encompass all ICT technological achievements supporting true ambient-assisted living (AAL) including capabilities for better living and healthcare organization. ELE promotes the provision of infrastructures and services for better living via the seamless integration of ICT within homes and residences, thus increasing the quality of life of human beings, maintaining one's home as a preferable living environment for as long as possible and not causing disruption in the web of social and family interactions. AAL aims to construct safe environments around assisted peoples (and local/remote caregivers/family members) in order to help them maintain independent and/or more autonomous lifestyle. Finally, AAL/ELE technologies allow the creation of personal living environments (PLEs) concerned with not only medical or fitness related functionalities but also social isolation, stress level, emotional state, etc.

Most efforts today towards the realization of AAL/ELE systems are based on developing specialized devices and the use of ambient intelligence to integrate these devices together to construct a safe PLE. There is a missing interaction of multiple stakeholders needing to collaborate for ELE supporting a multitude of AAL services, as well as barriers to innovation in the markets concerned, the governments, and health care sector. These innovations do not yet take place at a relevant scale.

Many fundamental issues in the ELE area remain open. Most of the current efforts still do not fully express the power of human being, and the importance of social connections and societal activities is less noticed. Effective ELE solutions require appropriate ICT algorithms, architectures and platforms, having in view the advance of science in this area and the development of new and innovative connected solutions (particularly in the area of smart dust/dew/fog/cloud computing). In this sense, the book aims to provide a platform for the dissemination of research efforts and presentation of advances in the ELE area that explicitly aim at addressing these challenges.

The book is intended for use by different professionals from medical doctors, ICT specialists, mathematicians, engineers and programmers to caregivers and

third parties like insurance companies' personnel and end users. It could be used as a notebook in the related curriculum. The chapters could be read in any order.

The overall objectives of this book are to:

- Offer an up-to-date analysis of architectures, techniques, protocols, components and development related to the AAL and ELE areas.
- Explain state-of-the-art technological solutions for the main AAL/ELE issues, stressing on computing and sensors.
- Demonstrate the importance of the emotional status of people in their living environment.
- Present the AAL/ELE benefits along with the development process of scientific and commercial applications and platforms.

The book's mission is to make readers familiar with these concepts and technologies that are successfully used in the implementation of today's AAL/ELE systems or are promising in future developments. The approach is more practical than theoretical, defining different concepts under a hierarchical reference model for ELE. The interdisciplinary nature of the topic brings together also an interdisciplinary team of authors that presented different views on the topic. The book contains many examples showing specific applications and highlighting possibilities for the integration on a generic platform.

The book presents also up-to-date technological solutions to the main aspects regarding AAL/ELE systems and applications including computing and artificial intelligence. The aim is to demonstrate the process started with AAL labs by further transforming these into islands with rich capabilities. This will allow crystallization and refinement of specifications and definitions, and will provide possibilities to offer appropriate services to broad public aiming at the same time to decrease the cost of their provision. The book discusses contemporary AAL/ELE technologies designed to solve some of the thorniest business problems affecting applications in areas such as health and medical supply, smart cities and smart houses, big data, Internet of Things (IoT) and many more.

The book consists of 14 chapters that are grouped logically depending on its respective topics. Chapter 1 is an introduction to ELE. Chapter 2 deals with ELE from the viewpoint of the socioecological psychology. It highlights an interesting approach towards the emotional state of people under monitoring. Chapter 3 explains pervasive sensing for social connectedness and enriches the topic of Chapter 2. Chapter 4 presents a specific view towards elderly, raising also some ethical issues.

Chapter 5 defines in a more technical way how the end users, AAL and ELE address service scenarios within a smart PLE. Chapter 6 demonstrates an interesting measurement of stress. An application of artificial intelligence in searching for health information is shown in Chapter 7.

Chapters 8 and 9 relate to communications and networking aspects of AAL/ELE platforms and systems along with their architectures and possible implementations.

A broad analysis of the linear wireless sensor networks (LWSNs) and protocols for use in the next-generation networks is included in Chapter 10. A theoretical approach towards the actual software implementation on the target ELE platform is shown in Chapter 11. Chapter 12 presents the use of wireless body area networks for health monitoring along with corresponding challenges, topology design and thermal issues. Chapter 13 presents an interesting survey on the wearable health-care technology. Chapter 14 presents a sophisticated intelligent system for after-stroke home rehabilitation.

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Book Editors