Lecture Notes of the Institute
for Computer Sciences, Social Informatics
and Telecommunications Engineering

Editorial Board

Ozgur Akan
  Middle East Technical University, Ankara, Turkey
Paolo Bellavista
  University of Bologna, Bologna, Italy
Jiannong Cao
  Hong Kong Polytechnic University, Hong Kong, Hong Kong
Geoffrey Coulson
  Lancaster University, Lancaster, UK
Falko Dressler
  University of Erlangen, Erlangen, Germany
Domenico Ferrari
  Università Cattolica Piacenza, Piacenza, Italy
Mario Gerla
  UCLA, Los Angeles, USA
Hisashi Kobayashi
  Princeton University, Princeton, USA
Sergio Palazzo
  University of Catania, Catania, Italy
Sartaj Sahni
  University of Florida, Florida, USA
Xuemin Sherman Shen
  University of Waterloo, Waterloo, Canada
Mircea Stan
  University of Virginia, Charlottesville, USA
Jia Xiaohua
  City University of Hong Kong, Kowloon, Hong Kong
Albert Y. Zomaya
  University of Sydney, Sydney, Australia
More information about this series at http://www.springer.com/series/8197
Internet of Things Technologies for HealthCare

Third International Conference, HealthyIoT 2016
Västerås, Sweden, October 18–19, 2016
Revised Selected Papers

Springer
Preface

The EAI International Conference on IoT Technologies for HealthCare (HealthyIoT) focuses on Internet of Things (IoT) technologies for health care. The 2016 conference was the third scientific event in the series bringing together expertise from technological, medical, social, and political domains. The IoT, as a set of existing and emerging technologies, notions, and services, can provide many solutions for the delivery of electronic health care, patient care, and medical data management. The event brought together technology experts, researchers, industry and international authorities contributing toward the assessment, development, and deployment of health care solutions based on IoT technologies, standards, and procedures. HealthyIoT 2016 also included the First Workshop on Emerging eHealth through Internet of Things (EHIoT 2016). Thus, it opened a new chapter in the success story of the series of international conferences on HealthyIoT by presenting keynotes, oral presentations, short poster presentations, and the workshop provided by more than 100 authors from 15 countries from various parts of the world.

HealthyIoT 2016 benefited from the experience and the lessons learned from the Organizing Committees of previous HealthyIoT events, particularly HealthyIoT 2014 and HealthyIoT 2015. Both conferences were co-located events that took place in Rome, Italy, forming one of the main conferences of the IoT360 Summit. The conferences were organized by CREATE-NET in collaboration with the European Alliance for Innovation in Slovakia, and its partner, the European Alliance for Innovation in Trento, Italy. Additionally, HealthyIoT 2015 also included the First Workshop on Embedded Sensor Systems for Health through Internet of Things (ESS-H IoT 2015) with the aim of using embedded sensor systems in health monitoring applications considering the future vision of IoT.

This proceedings volume comprises a total of 31 research papers out of 43 submissions, with contributions by researchers across Europe and around the world. Among them, 20 oral presentations to the HealthyIoT 2016 conference, eight poster presentations, and three oral presentations to the EHIoT 2016 workshop. All submissions were carefully and critically reviewed by at least two independent experts from the scientific Program Committee and international reviewers. The highly selective review process resulted in an acceptance rate of 72%, thereby guaranteeing a high scientific level of the accepted and finally published papers. The publication includes manuscripts written and presented by authors from different countries, including the UK, Sweden, Turkey, Japan, Belgium, Saudi Arabia, United States, Portugal, Italy, Thailand, Slovakia, France, Pakistan, Australia, and Bosnia and Herzegovina. Topics including “Health-Care Support for the Elderly,” “Real-Time Monitoring Systems,” “Security, Safety and Communication,” “Smart Homes and Smart Caring Environments,” “Intelligent Data Processing and Predictive Algorithms in eHealth,” “Emerging eHealth IoT Applications,” “Signal Processing and Analysis,” and “The Smartphone as a HealthyThing,” are covered.
The HealthyIoT 2016 conference would not have been possible without the supporters and sponsors including the European Alliance for Innovation (EAI), CREATE-NET, Springer, Mälardalen University, Microsoft, and other the local sponsors.

The editors are also grateful to the dedicated efforts of the Organizing Committee members and their supporters for carefully and smoothly preparing and operating the conference. They especially thank all team members from the Embedded Sensor Systems for Health, Mälardalen University, Västerås, Sweden, for their dedication to the event. In conclusion, we would like to once again express our sincere thanks to all the authors and attendees of the conference in Västerås, Sweden, and also the authors who contributed to the creation of this HealthyIoT 2016 publication.

November 2016

Mobyen Uddin Ahmed
Shahina Begum
Wasim Raad
Organization

The 3rd EAI International Conference on IoT Technologies for HealthCare

General Chair
Mobyen Uddin Ahmed  Mälardalen University, Sweden

Steering Committee Chair
Imrich Chlamtac  President of Create-Net, President of European Alliance for Innovation, Italy

Steering Committee
Joel J.P.C. Rodrigues  Instituto de Telecomunicações, University of Beira Interior, Portugal
Antonio J. Jara  Institute of Information Systems, University of Applied Sciences Western Switzerland (HES-SO), Switzerland
Shoumen Palit Austin Datta  School of Engineering Massachusetts Institute of Technology; Industrial Internet Consortium, USA
Arijit Ukil  Tata Consultancy Services, India

Technical Program Chairs
Antonio J. Jara  Institute of Information Systems, University of Applied Sciences Western Switzerland (HES-SO), Switzerland
Stefania Montani  DISIT - Computer Science Institute, Italy
Shahina Begum  Mälardalen University, Sweden
Diego Gachet Páez  Universidad Europea de Madrid, Spain

Publications Chairs
Wasim Raad  King Fahd University of Petroleum and Minerals, Saudi Arabia
Shahina Begum  Mälardalen University, Sweden
Program Committee

Jesus Favela CICESE, Mexico
Marcela Rodriguez UABC, Mexico
Manuel de Buenaga Universidad Europea de Madrid, Spain
Carmelo R. García Universidad de Las Palmas de Gran Canaria, Spain
Ramiro Delgado Army Forces University, Ecuador
Kunal Mankodiya University of Rhode Island, USA
Malcolm Clarke Brunel University, UK
Emilija Stojmenova Duš University of Ljubljana, Slovenia
Yunchuan Sun China University of Geosciences (Beijing), China
Enrique Puertas Universidad Europea de Madrid, Spain
Alan Jovic University of Zagreb, Croatia
Ahsan Khandoker Khalifa University, United Arab Emirates
Mobyen Uddin Ahmed Mälardalen University, Sweden
Venet Osmani CREATE-NET, Italy
Faisal Shaikh Mehran University of Engineering and Technology, Pakistan
Emad Felemban Science and Technology Unit, UQU University, Makkah, Saudi Arabia
Silvia Gabrielli CREATE-NET, Italy
Gregory Abowd Gatech, USA
Arijit Ukil Scientist R&D, Tata Consultancy Services, India
Mosabber Uddin Ahmed University of Dhaka, Bangladesh
Rossi Kamal Kyung Hee University, South Korea
Stefano Tennina University of L’Aquila, Italy
Mário Alves Polytechnic Institute of Porto (ISEP/IPP), Portugal
Anis Koubâa Prince Sultan University, Saudi Arabia
Ramiro Martinez de Dios University of Seville, Spain
Shashi Prabh Shiv Nadar University, India
Carlo Alberto Boano TU Graz, Austria
Behnam Dezfooli University of Iowa, USA

Sponsorship and Exhibit Chairs

Kristina Lukacova European Alliance for Innovation, Slovakia
Therese Jagestig Bjurquist Mälardalen University, Sweden

Workshops Chair

Aida Čaušević Mälardalen University, Sweden

Publicity and Social Media Chair

Hossein Fotouhi Mälardalen University, Sweden
Web Chair
Shaibal Barua  Mälardalen University, Sweden

Local Chairs
Hossein Fotouhi  Mälardalen University, Sweden
Aida Čaušević  Mälardalen University, Sweden

Advisors
Maria Lindén  Mälardalen University, Sweden
Mats Björkman  Mälardalen University, Sweden

Conference Manager
Lenka Laukova  EAI - European Alliance for Innovation

Workshop on Emerging eHealth through Internet of Things

Organizing Committee
Almir Badnjević  International Burch University and University of Sarajevo, Bosnia and Herzegovina
Radovan Stojanović  University of Montenegro, Montenegro
Mario Cifrek  University of Zagreb, Croatia

Program Committee
Thomas Penzel  Charite University Hospital Berlin, Germany
Leonardo Bocchi  University of Florence, Italy
Damir Marjanović  International Burch University, Bosnia and Herzegovina
Ratko Magjarević  University of Zagreb, Croatia
Miroslav Končar  Oracle Healthcare Zagreb, Croatia
Almira Hadžović-Džuvo  University of Sarajevo, Bosnia and Herzegovina
Anne Humeau-Heurtier  University of Angers, France
Tamer Bego  University of Sarajevo, Bosnia and Herzegovina
Leandro Pecchia  University of Warwick, UK
Dušanka Bošković  University of Sarajevo, Bosnia and Herzegovina
Paulo Carvalho  University of Coimbra, Portugal
Jasmin Azemović  International Burch University, Bosnia and Herzegovina
Contents

Main Track (Full Papers)

Ecaring@Home: A Distributed Research Environment on Semantic Interoperability .................................................. 3
Amy Loutfi, Arne Jönsson, Lars Karlsson, Leili Lind, Maria Linden, Federico Pecora, and Thiemo Voigt

Halmstad Intelligent Home - Capabilities and Opportunities ................. 9
Jens Lundström, Wagner O. De Morais, Maria Menezes, Celeste Gabrielli, João Bentes, Anita Sant'Anna, Jonathan Synnott, and Chris Nugent

Healthcare Needs, Company Innovations, and Research - Enabling Solutions Within Embedded Sensor Systems for Health ......................... 16
Maria Lindén, Therese Jagestig Bjurquist, and Mats Björkman

A Case-Based Classification for Drivers’ Alcohol Detection Using Physiological Signals ................................................. 22
Hamidur Rahman, Shaibal Barua, Mobyen Uddin Ahmed, Shahina Begum, and Bertil Hök

Towards a Probabilistic Method for Longitudinal Monitoring in Health Care ................................................................. 30
Ning Xiong and Peter Funk

A Classification Model for Predicting Heart Failure in Cardiac Patients ...... 36
Muhammad Saqlain, Rao Muzamal Liaqat, Nazar A. Saqib, and Mazhar Hameed

Ins and Outs of Big Data: A Review .................................................... 44
Hamidur Rahman, Shahina Begum, and Mobyen Uddin Ahmed

A Review of Parkinson’s Disease Cardinal and Dyskinetic Motor Symptoms Assessment Methods Using Sensor Systems ................... 52
Somayeh Aghanavesi and Jerker Westin

Why Hackers Love eHealth Applications ........................................ 58
Rohit Goyal and Nicola Dragoni

Reliable Communication in Health Monitoring Applications ................. 64
Hossein Fotouhi, Maryam Vahabi, Apala Ray, and Mats Björkman
Security Context Framework for Distributed Healthcare IoT Platform . . . . . . 71
Orathai Sangpetch and Akkarit Sangpetch

BitRun: Gamification of Health Data from Fitbit® Activity Trackers . . . . . . 77
Rachel Gawley, Carley Morrow, Herman Chan, and Richard Lindsay

Smartphone-Based Decision Support System for Elimination
of Pathology-Free Images in Diabetic Retinopathy Screening . . . . . 83
João Costa, Inês Sousa, and Filipe Soares

Improving Awareness in Ambient-Assisted Living Systems:
Consolidated Data Stream Processing . . . . . . . . . . . . . . . . . . . . . . . . . . . 89
Koray İnçki and Mehmet S. Aktaş

Beyond ‘Happy Apps’: Using the Internet of Things to Support
Emotional Health . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . 95
Jeanette Eriksson and Nancy L. Russo

Massimo Canonico, Stefania Montani, and Manuel Striani

Perception of Delay in Computer Input Devices Establishing a Baseline
for Signal Processing of Motion Sensor Systems . . . . . . . . . . . . . . . . . . . . . 107
Jiaying Du, Daniel Kade, Christer Gerdman, Rikard Lindell,
Özgür Özcan, and Maria Lindén

Telemetry System for Diagnosis of Asthma and Chronical Obstructive
Pulmonary Disease (COPD) . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . 113
Eldar Granulo, Lejla Bećar, Lejla Gurbeta, and Almir Badnjević

Remotely Supporting Patients with Obstructive Sleep Apnea at Home . . . . . 119
Xavier Rafael-Palou, Alexander Steblin, and Eloisa Vargiu

An Aggregation Plateform for IoT-Based Healthcare: Illustration for
Bioimpedancemetry, Temperature and Fatigue Level Monitoring . . . . . 125
Antoine Jamin, Jean-Baptiste Fasquel, Mehdi Lhommeau,
Eva Cornet, Sophie Abadie-Lacourtoisie, Samir Henni,
and Georges Leftheriotis

Posters (Short Papers)

SmartMirror: An Embedded Non-contact System for Health
Monitoring at Home . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . 133
Hamidur Rahman, Shankar Iyer, Caroline Meusburger,
Kolja Dobrovolski, Mihaela Stoycheva, Vukan Turkulov,
Shahina Begum, and Mobyen Uddin Ahmed
The E-Care@Home Infrastructure for IoT-Enabled Healthcare ........................................... 138
Nicolas Tsiftes, Simon Duquennoy, Thiemo Voigt, Mobyen Uddin Ahmed, Uwe Köckemann, and Amy Loutfi

CAMI - An Integrated Architecture Solution for Improving Quality of Life of the Elderly ................................................................. 141
A. Sorici, I.A. Awada, A. Kunnappilly, I. Mocanu, O. Cramariuc, L. Malicki, C. Seceleanu, and A. Florea

Driver’s State Monitoring: A Case Study on Big Data Analytics ..................................... 145
Shaibal Barua, Shahina Begum, and Mobyen Uddin Ahmed

Falling Angel – A Wrist Worn Fall Detection System Using K-NN Algorithm ................................. 148
Hamidur Rahman, Johan Sandberg, Lennart Eriksson, Mohammad Heidari, Jan Arwald, Peter Eriksson, Shahina Begum, Maria Lindén, and Mobyen Uddin Ahmed

RFID Based Telemedicine System for Localizing Elderly with Chronic Diseases ......................... 152
M.W. Raad and Tarek Sheltami

Design and Implementation of Smartphone-Based Tear Volume Measurement System ...................... 155
Yoshiro Okazaki, Tatsuki Takenaga, Taku Miyake, Mamoru Iwabuchi, Toshiyuki Okubo, and Norihiro Yokoi

Towards an IoT Architecture for Persons with Disabilities and Applications ................................ 159
Jihene Haouel, Hind Ghorbel, and Hichem Bargaoui

EHIoT Workshop (Full Papers)

Security and Privacy Issues in Health Monitoring Systems: eCare@Home Case Study ................................. 165
Thomas Wearing and Nicola Dragoni

Design of IoT Solution for Velostat Footprint Pressure Sensor System ........................................ 171
Haris Muhedinovic and Dusanka Boskovic

Test-Retest and Intra-rater Reliability of Using Inertial Sensors and Its Integration with Microsoft Kinect™ to Measure Shoulder Range-of-Motion .................................................... 177
Peter Beshara, Judy Chen, Pierre Lagadec, and W.R. Walsh

Author Index ...................................................................................................................... 185