The Future of eHealth: Applications, Solutions, and New Visions in the IoT Era


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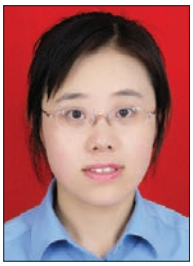
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The employment of digital technologies and new paradigms are opening the doors to innovative prospects for the future of eHealth worldwide. Traditional Information and Communications Technologies (ICT) are evolving into molecular communications, and artificially created boundaries between medicine and ICT will be removed in order to take advantage of the new opportunity to dramatically improve the precision of medical diagnosis and therapeutics. The Internet of Things (IoT) paradigm is emerging as one of the most trending topics of technology in recent years since it gives rise to a number of trends and services related to different scenarios. Therefore, thanks to its multidisciplinary approach, IoT is actually revolutionizing many aspects of traditional healthcare paradigms since traditional healthcare systems can no longer satisfy the needs of a continuously growing and developing society. Indeed, nowadays, the world needs to face the aging of the population and the inherent need of assisted-living environments for elderly people. The goal of this Feature Topic (FT) is to publish innovative IoT solutions for eHealth, bringing together researchers from academia into a common platform to advance the state-of-the-art of eHealth by eliciting new applications and disruptive solutions for medical science and healthcare. The theme of this FT is three-fold: i) to discuss the latest advancements in the field of IoT for eHealth by presenting innovative and efficient solutions; ii) to illustrate aspects of applying IoT in healthcare experimental results to analyze the effects over lifestyle and healthcare systems and the response to technology-assisted medical care and treatments; and iii) to give further directions for research, new problems and challenges in eHealth.

The article "Edge Intelligence for Empowering IoT-based Healthcare Systems" by Hayyolalam *et al*. employs edge computing technology to reduce latency and energy consumption by moving processes closer to the data sources in comparison to the traditional centralized cloud and IoT-based healthcare systems. The authors highlight the benefits of the adoption of edge intelligent technology, along with AI in smart healthcare systems. Moreover, they propose a novel smart healthcare model to boost the utilization of AI and edge technology in smart healthcare systems.

The article "The Internet of UAVs-based Remote Health Monitoring: An Online eHealth System" by Dong *et al*. proposes an online eHealth system to monitor patients and provides edge computing services based on the Internet of Unmanned Aerial Vehicles (UAVs). In order to minimize the health monitoring latency and guarantee resource utilization efficiency of UAVs, the authors employ the Lyapunov optimization method. Finally, extensive experimental results demonstrate the effectiveness of the proposed system.

The article "Two Ways for Early Detecting a Stroke through a Wearable Smart Helmet: Signal Processing versus Electromagnetism" by Bisio *et al*. tackles the problem of detecting a brain stroke (BS). To this aim, the authors present a prototype of a smart helmet thought to be employed on site, to efficiently recognize and detect a brain stroke in patients when the first aid medical team arrives. This work presents two different yet complementary approaches: i) a signal processing-based (SP) approach, and ii) an ElectroMagnetic (EM) approach. The authors analyze both approaches showing their strengths and highlighting their weaknesses.

The article "Non-invasive Wearable Optical Sensors for Full Gait Analysis in e-Health Architecture" by Radwan *et al*. tackles the problem of impaired and physically debilitated people by introducing the design and implementation of a non-invasive wearable architecture for full gait analysis, enabled by optical fiber Bragg grating sensors. The proposed sensing network provides the necessary tools to simultaneously monitor parameters, including foot plantar pressure, muscle peak activity and ankle and knee range of motion, with high precision, without the need for any synchronization or delay adjustments between multiple sensors.

The article "A Deep Segmentation Network of Stent Structs based on IoT for Interventional Cardiovascular Diagnosis" by Lloret *et al*. proposes an IoT eHealth framework to provide an autonomous solution for patients with cardiovascular disease. In this framework, wearable sensors are used to collect a patient's health data, which is monitored daily by a remote doctor. When the monitoring data is abnormal, the remote doctor will ask for image acquisition of the patient's cardiovascular internal conditions. The authors leverage edge computing to classify these training images by the local base classifier, and thereafter the pseudo-labels are generated according to its output.

We honestly believe that this Feature Topic is delivering cutting-edge research in the eHealth field by proposing interesting works and brand new ideas. We, as the Guest Editors, would like to encourage each and every author to continue

pushing in this direction by addressing the remaining open issues. Finally, we would like to sincerely thank Prof. Yi Qian, the Editor-in-Chief of *IEEE Wireless Communications*, for supporting this Feature Topic, and Joseph Milizzo for the great help in the whole production process.

Biographies

Andrea Sciarrone was born in Livorno, Italy in 1984. He received his Bachelor Degree in telecommunication engineering at the University of Genoa in 2007, and the Master Degree cum laude in telecommunication engineering in 2009 from the same university with a thesis on audio signal processing. In 2014 he received the Ph.D. degree in ambient intelligence from the Univerisity of Genoa with a thesis on signal processing algorithms for context-aware applications over mobile platforms. He is currently an assistant professor and member of the research staff of the Telecommunication Research Group, and in particular of the Digital Signal Processing (DSP) Laboratory at the University of Genoa. He is a member of the IEEE Communications Society (ComSoc) and IEEE Signal Processing Society (SPS). Since January 2020 he has served as Vice-Chair of the IEEE ComSoc E-health Technical Committee. He is the author of approximately 70 papers including journals and conferences proceedings. He is the recipient of the IEEE Cloudnet 2016 Best Paper Award. His research concerns signal processing over Internet of Things, context and location awareness and safety and e-health applications.

Joel J. P. C. Rodrigues [F] is a professor at the Federal University of Piauí (UFPI), Brazil, and a senior researcher at the Instituto de Telecomunicações, Portugal. He is the leader of the Next Generation Networks and Applications (NetGNA) research group (CNPq), an IEEE Distinguished Lecturer, Member Representative of the IEEE Communications Society on the IEEE Biometrics Council, and the President of the scientific council at ParkUrbis – Covilhã Science and Technology Park. He was Director for Conference Development–IEEE ComSoc Board of Governors, Technical Activities Committee Chair of the IEEE ComSoc Latin America Region Board, a Past-Chair of the IEEE ComSoc Technical Committee (TC) on eHealth and the TC on Communications Software, a Steering Committee member of the IEEE Life Sciences Technical Community and Publications co-Chair. He is the editor-in-chief of the *International Journal of E-Health and Medical Communications* and editorial board member of several highly-respected journals (mainly from IEEE). He has been General Chair and TPC Chair of many international conferences, including IEEE ICC, IEEE GLOBECOM, IEEE HEALTHCOM, and IEEE LatinCom. He has authored or coauthored approximately 1000 papers in refereed international journals and conferences, three books, two patents, and one ITU-T Recommendation. He has been awarded several Outstanding Leadership and Outstanding Service Awards by the IEEE Communications Society and several best papers awards. He is a member of the Internet Society, a senior member of ACM, and a Fellow of the IEEE.

Dan Wu received the B.S., M.S., and Ph.D. degrees from the Institute of Communications Engineering, PLA University of Science and Technology, Nanjing, China, in 2006, 2009, and 2012, respectively. She is currently an associate professor with the Army Engineering University of PLA, Nanjing. Her research interests include resource allocation and management, game theory, cooperative communications, and wireless sensor networks.

Jia Chen is an Offering Leader of Blockchain solutions for Healthcare and Life Sciences at IBM's Innovation and Solution Incubation team. She serves on the IBM Academy of Technology Leadership team. She previously led technical strategy at IBM Watson Health Innovation, with a focus on data and AI. Prior to that, she was the global leader of Watson Experience Centers at IBM, responsible for Watson AI client experiences across all Watson groups. She held leadership positions for Innovation and Client Engagement at IBM Corporate Headquarters as well as emerging markets. She was formerly the Director of Health Solutions for Smarter Cities at IBM, and the Director of Technical Sales & Innovation for IBM's Growth Market Units. She led the identification, structuring and execution of first of a kind technology and business initiatives that provide innovative and sustainable differentiation for IBM's clients. She received her Ph.D. in physics from Yale University. She was named as one of the top 35 technology innovators under the age of 35 worldwide by MIT's Technology Review in 2005, Best Researcher of the Year by *Small Times Magazine* in 2006, and one of the top 26 tech women innovators at IBM in 2015. She serves on the Yale Graduate School Alumni Association Board.