Wearable Sensing and Intelligent Data Analysis for Respiratory Management
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Wearable Sensing and Intelligent Data Analysis for Respiratory Management

Edited by

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Preface

Respiratory diseases, such as chronic obstructive pulmonary disease (COPD), lower respiratory tract infections, or asthma, have significant impact on patient’s health-related quality of life, health-care systems, and society in general. Recent studies estimate that, worldwide, around 339 million people suffer from asthma and that, by 2030, COPD will become the third leading cause of death. This poses severe burdens to health-care systems in terms of outpatient and inpatient care, as well as pharmaceutical costs, which are highly correlated with the severity of exacerbation episodes.

In this scenario, the use of wearable sensing and intelligent data analysis algorithms for respiratory management assumes particular relevance, offering several potential clinical benefits. Namely, it allows for the early detection of respiratory exacerbations in patients with chronic respiratory diseases, allowing earlier and, therefore, more effective treatment. Early intervention in exacerbations of these conditions has been shown to decrease hospitalization rates and improve long-term outcomes, including survival.

As such, presently, the problem of continuous, noninvasive, remote, and real-time monitoring of such patients is deserving increasing attention from the scientific community. Wearable and portable systems with sensing technology and automated analysis of respiratory sounds and pulmonary images are some of the problems that are the subject of current research efforts. Such systems have the potential for substantial clinical benefits, promoting the so-called P4 medicine (personalized, participative, predictive, and preventive).

To this end, this book covers the most recent research and development on wearable technologies for respiratory management. The book, organized into 4 parts and 11 chapters, starts with an introductory overview of the process of respiration, its physiology, pathologies, and treatment, followed by the current needs and gaps of respiratory management in daily life. The second part addresses the aspects involved on wearable sensing, namely portable and noninvasive sensor technologies for mobile and wearable applications, and textiles and smart materials. Part III covers the data analysis and management pipeline, from data acquisition, transmission, storage, and representation, to feature engineering and machine learning for respiratory sound and image analysis. Finally, Part
IV addresses the current key challenges of respiratory management systems, namely the edge-cloud continuum in wearable sensing, strategies for long-term patient adherence, decision support systems, and integrated care in respiratory management.

We believe this book offers three main distinctive features: (i) an integrated, unified, and holistic coverage of the main topics and trends in wearable sensing and intelligent data analysis for respiratory management; (ii) an up-to-date review of the current trends and hot topics in the different subfields (e.g., wearable technologies, respiratory sound analysis, and pulmonary image analysis, particularly electrical impedance tomography); (iii) a comprehensive guide for starting researchers, namely, PhD students, offering them the necessary tools to start performing cutting-edge research in their area of interest.

Hence, this book will best suit the needs of researchers, particularly PhD students, working on different aspects of engineering issues for respiratory function management, namely in the areas of biomedical engineering, informatics engineering, electrical engineering, and data science and engineering. It will also work as an integrated and comprehensive entry point for any researcher who needs a holistic overview of the field. Health-care professionals will also benefit from the topics covered in the book, which aim at the active promotion of P4 medicine.

As such, the reader will be able to make use of the book mainly in two ways: (i) as someone with a broad interest in the whole process of technology use for respiratory management, where the whole book will offer the reader a broad and deep understanding of the area; (ii) as a researcher aiming to acquire specific knowledge in some of the identified subtopics, in which case the reader might be interested in the chapters setting the big picture of the whole field and then focusing on a specific subtopic.

Rui Pedro Paiva
Paulo de Carvalho
Vassilis Kilintzis
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