EAI/Springer Innovations in Communication and Computing

Pedro R. M. Inácio
Ana Duarte
Paulo Fazendeiro
Nuno Pombo *Editors*

5th EAI International Conference on IoT Technologies for HealthCare

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Through its open free membership model EAI promotes a new research and innovation culture based on collaboration, connectivity and recognition of excellence by community.

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Editors
Pedro R. M. Inácio
Instituto de Telecomunicações
Universidade da Beira Interior
Covilhã, Portugal

Ana Duarte
Department of Health Sciences
Universidade da Beira Interior
Covilhã, Portugal

Paulo Fazendeiro
Instituto de Telecomunicações
Universidade da Beira Interior
Covilhã, Portugal

Nuno Pombo
Instituto de Telecomunicações
Universidade da Beira Interior
Covilhã, Portugal

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Preface

The Internet of Things, a paradigm leveraging a set of existing and emerging technologies, notions, and services, can provide many solutions to delivery of electronic healthcare, patient care, and medical data management. The proceedings of the fifth edition of the European Alliance for Innovation (EAI) International Conference on Internet of Things Technologies for Healthcare (HealthyIoT 2018) are a representative snapshot of the ongoing research efforts being made to achieve these goals.

The technical program of HealthyIoT 2018 consisted of two keynote speeches (*IoT Sensors in the Framework of Aging in Place* and *Pervasive Electrocardiography* delivered, respectively, by the researchers Bart Vanrumste and Hugo Silva) and 10 papers encompassing basic and applied research in themes as diverse as the study of materials for mobile off-the-person ECG, the use of intelligent phonocardiography for screening pediatric heart disease, the monitoring of respiratory rate for early detection of diseases, the sleep detection with wearable devices, the remote rehabilitation via exergaming, the study of EMG sensors for a bionic hand, the future expectations on telemonitoring devices and systems, the security solutions for e-health information systems, and the development of ontologies to manage the huge amounts of heterogeneous medical devices and data.

There are sets of different actors that have contributed to the success of this meeting. First of all, we are in debt to the authors who generously have submitted and shared their most recent research endeavors. We also commend the hard work of the members of the Technical Program Committee for being part of the peer-review process of technical papers thus ensuring a high-quality technical program. It was also a great pleasure to work with the excellent organizing committee team for their hard work in organizing and supporting the conference. Last, but not least, we also appreciate the constant support and guidance from the steering chair, Imrich Chlamtac, and from the always-present Conference Managers.

As a final remark, we sincerely believe that HealthyIoT has succeeded in bringing together technology experts, researchers, industry and international authorities that are nowadays contributing towards the design, development and deployment of healthcare solutions based on IoT technologies, standards, and procedures.

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Contents

Part I
Devices and Materials

Study of Mechanomyographic Alternatives to EMG Sensors for a Low-Cost Open Source Bionic Hand

Joana Marques, Sara Ramos, Milton P. Macedo, and Hugo Plácido da Silva

1 Introduction

Owing to the huge evolution in the sensor and microprocessor technologies, as well as in 3D (Three-Dimensional) printing, the development of prosthesis has undergone a great transformation. Particularly for the hand, the myoelectric solution is still the choice of the majority of amputees, although limited by the prohibitive price of bionic hands. Differences are in the versatility of each solution, because in the myoelectric case the hand is opened and closed being able to grasp objects. In opposition, bionic hands are capable of executing individual motions of the fingers, subsequently having a higher functionality approaching the human hand. There is a plethora of commercial hands with a wide range of costs; two of them are shown in Fig. 1. Its cost greatly varies from 5 to 50 k euros, for Open Bionics and Michelangelo hands.

The aim of this work is to study the effectiveness of low-cost sensors for the replacement of EMG (ElectroMyography) sensors commonly used for upper-limb prosthesis. Any movement/gesture executed by a human hand is triggered by command signals sent by the brain, and it implies the ability of nervous cells

J. Marques · S. Ramos
Instituto Politécnico de Coimbra, ISEC, DFM, Rua Pedro Nunes, Quinta da Nora, Coimbra, Portugal

M. P. Macedo (✉)
Instituto Politécnico de Coimbra, ISEC, DFM, Rua Pedro Nunes, Quinta da Nora, Coimbra, Portugal

LIBPhys, Department of Physics, University of Coimbra, Rua Larga, Coimbra, Portugal
e-mail: mpmacedo@isec.pt

H. P. da Silva
IT - Instituto de Telecomunicações, Lisbon, Portugal

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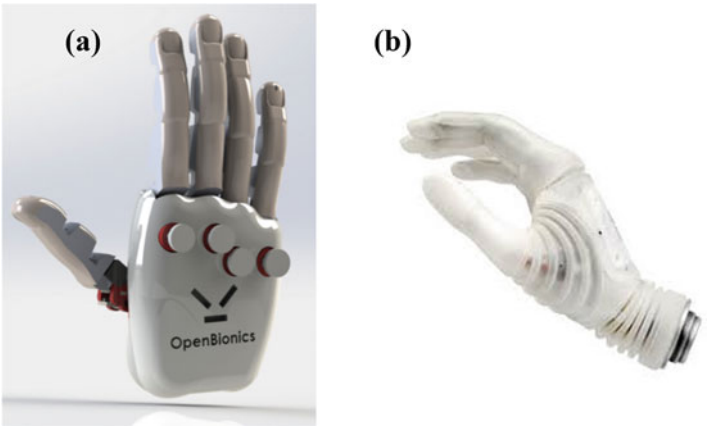

Fig. 1 Examples of commercial hands. Open Bionics (**a**) and Michelangelo (**b**)

to transmit electrical signals. In the typical approach, EMG sensors acquire these myoelectric signals through electrodes placed in appropriate locations, taking into consideration the muscles involved in each movement.

Surface-mounted electrodes are preferably used in case muscles provide signals with enough intensity to be detected. These electrodes, placed on the skin surface, capture the aggregated activity within the area of detection. Three electrodes are used with their locations being chosen depending on the muscles activated in a certain gesture. One of the electrodes is the ground electrode, typically placed in a bone region (electrical neutral) and the other two are active electrodes that collect a signal whose amplitude is proportional to the electrical activity differential between them, and also to the electrode area.

In spite of the typical approach of using EMG signals, there are some drawbacks that have led to the attempts of extracting other type of information, namely to predict muscle forces from EMG signals using the wavelet transform [1]. One of those drawbacks is the often degradation of EMG signals due to electromagnetic interference which implies a large processing time for features extraction [2].

In contrast, the mechanical change of the muscles can be measured by a method with sensitivity to the position/motion of a small area in surface of the muscle, and is typically known as MMG (MechanoMyography). The possibility of acquiring a mechanical deformation map seems potentially interesting as the shape of the muscles changes when different sets of fingers are moved. It has already been implemented using FSR (Force Sensitive Resistor) [2]. Also the application of load cells is described in literature [3].

Another obvious choice to detect mechanical changes is light instrumentation. Amongst the vast offer in these types of sensors, affordable options are available that integrate, in a single package, a light source and detector that could be easily linked to a biosignals acquisition hardware platform.