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Biomedical Engineering Systems and Technologies

Third International Joint Conference, BIOSTEC 2010
Valencia, Spain, January 2010
Revised Selected Papers

Ana Fred Joaquim Filipe Hugo Gamboa (Eds.)

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Preface

The present book includes extended and revised versions of a set of selected papers from the Third International Joint Conference on Biomedical Engineering Systems and Technologies (BIOSTEC 2010), organized by the Institute for Systems and Technologies of Information Control and Communication (INSTICC), technically co-sponsored by the IEEE Engineering in Medicine and Biology Society (EMB), and in cooperation with AAAI, Workflow Management Coalition (WfMC), ACM SIGART, Universidad Politecnica de Valencia and Centro en Red en Ingeniería Biomédica (CRIB).

The purpose of the International Joint Conference on Biomedical Engineering Systems and Technologies is to bring together researchers and practitioners, including engineers, biologists, health professionals and informatics/computer scientists, interested in both theoretical advances and applications of information systems, artificial intelligence, signal processing, electronics and other engineering tools in knowledge areas related to biology and medicine.

BIOSTEC is composed of four co-located conferences; each specializes in one of the aforementioned main knowledge areas, namely:

- HEALTHINF (International Conference on Health Informatics) promotes research and development in the application of information and communication technologies (ICT) to healthcare and medicine in general and to the specialized support to persons with special needs in particular. Databases, networking, graphical interfaces, intelligent decision support systems and specialized programming languages are just a few of the technologies currently used in medical informatics. Mobility and ubiquity in healthcare systems, standardization of technologies and procedures, certification, privacy are some of the issues that medical informatics professionals and the ICT industry in general need to address in order to further promote ICT in healthcare.
- BIODEVICES (International Conference on Biomedical Electronics and Devices) focuses on aspects related to electronics and mechanical engineering, especially equipment and materials inspired by biological systems and/or addressing biological requirements. Monitoring devices, instrumentation sensors and systems, biorobotics, micro-nanotechnologies and biomaterials are some of the technologies addressed at this conference.
- BIOSIGNALS (International Conference on Bio-inspired Systems and Signal Processing) is a forum for those studying and using models and techniques inspired by or applied to biological systems. A diversity of signal types can be found in this area, including image, audio and other biological sources of information. The analysis and use of these signals is a multidisciplinary area including signal processing, pattern recognition and computational intelligence techniques, amongst others.

- BIOINFORMATICS (International Conference on Bioinformatics) focuses on the application of computational systems and information technologies to the field of molecular biology, including for example the use of statistics and algorithms to understanding biological processes and systems, with emphasis on new developments in genome bioinformatics and computational biology.

The joint conference, BIOSTEC, received 410 paper submissions from more than 55 countries in all continents. In all, 46 papers were published and presented as full papers, i.e., completed work (8 pages/30' oral presentation), 113 papers reflecting work-in-progress or position papers were accepted for short presentation, and another 78 contributions were accepted for poster presentation. These numbers, leading to a “full-paper” acceptance ratio of about 11% and a total oral paper presentation acceptance ratio close to 39%, show the intention of preserving a high-quality forum for the next editions of this conference.

The conference included a panel and four invited talks delivered by internationally distinguished speakers, namely: Peter D. Karp, Rui M. C. Ferreira, Tony Cass and Vicente Traver.

We must thank the authors, whose research and development efforts are recorded here. We also thank the keynote speakers for their invaluable contribution and for taking the time to synthesize and prepare their talks. Finally, special thanks to all the members of the INSTICC team, whose collaboration was fundamental for the success of this conference.

June 2010

Ana Fred
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Table of Contents

Invited Paper

Personal Health: The New Paradigm to Make Sustainable the Health Care System	3
<i>Vicente Traver and Raquel Faubel</i>	

Part I: Health Informatics

Registration and Fusion Techniques for Medical Images: Demonstration and Evaluation	15
<i>Evanthia Faliagka, George Matsopoulos, Athanasios Tsakalidis, John Tsaknakis, and Giannis Tzimas</i>	
Prediction of Pancreatic Cancer Survival through Automated Selection of Predictive Models.....	29
<i>Stuart Floyd, Carolina Ruiz, Sergio A. Alvarez, Jennifer Tseng, and Giles Whalen</i>	
Web of Active Documents: An Architecture for Flexible Electronic Patient Records.....	44
<i>Federico Cabitza and Iade Gesso</i>	
A Personalization Environment for Multi-version Clinical Guidelines....	57
<i>Fabio Grandi</i>	
Dynamic Routing Using Health Information Policy with Apache Camel	70
<i>Edward Brown and Jamie Goodyear</i>	
A Personal Health Record System for Emergency Case Management....	83
<i>Vassiliki Koufi, Flora Malamateniou, and George Vassilacopoulos</i>	
A Method for Representing and Querying Temporal Information in OWL.....	97
<i>Martin J. O'Connor and Amar K. Das</i>	
Designing a Telemedical System for Cardiac Exercise Rehabilitation	111
<i>Florian Klompmaker, Clemens Busch, Karsten Nebe, Andreas Bleiker, and Detlev Willemsen</i>	
A Value and Model Driven Method for Patient Oriented KPI Design in Health Care	123
<i>Erik Perjons and Paul Johannesson</i>	

Part II: Biomedical Electronics and Devices

Encapsulated Multi-vesicle Assemblies of Programmable Architecture: Towards Personalized Healthcare	141
<i>Maik Hadorn and Peter Eggenberger Hotz</i>	
Adaptive RBF-HMM Bi-Stage Classifier Applied to Brain Computer Interface	152
<i>José Luis Martínez Pérez and Antonio Barrientos Cruz</i>	
Thermal Characteristics of Microcantilever Biosensors	166
<i>Mohd. Zahid Ansari and Chongdu Cho</i>	
Prosodic Speech Restoration Device: Glottal Excitation Restoration Using a Multi-resolution Approach	177
<i>Olaf Schleusing, Rolf Vetter, Philippe Renevey, Jean-Marc Vesin, and Valérie Schweizer</i>	
An Investigation on ALD Thin Film Evanescent Waveguide Sensor for Biomedical Application	189
<i>Agung Purniawan, Paddy French, Gregory Pandraud, and Pasqualina M. Sarro</i>	

Part III: Bio-inspired Systems and Signal Processing

Probabilistic Patient Monitoring with Multivariate, Multimodal Extreme Value Theory	199
<i>Samuel Hugueny, David A. Clifton, and Lionel Tarassenko</i>	
Weighted SVMs and Feature Relevance Assessment in Supervised Heart Beat Classification	212
<i>Gael de Lannoy, Damien François, Jean Delbeke, and Michel Verleysen</i>	
The Investigation and Clinical Significance of Resonance in the Heart Rate and Vascular Tone Baroreflexes	224
<i>Eugeniy G. Vaschillo, Bronya Vaschillo, Jennifer F. Buckman, Robert J. Pandina, and Marsha E. Bates</i>	
Glottal Inverse Filtering of Speech Based on Homomorphic Prediction: A Cepstrum-Based Algorithm not Requiring Prior Detection of Either Pitch or Glottal Closure	238
<i>Rubén Fraile, Malte Kob, Juana M. Gutiérrez-Arriola, Nicolás Sáenz-Lechón, J. Ignacio Godino-Llorente, and Víctor Osma-Ruiz</i>	
Texture Discrimination with Artificial Whiskers in the Robot-Rat Psikharpax	252
<i>Steve N'Guyen, Patrick Pirim, and Jean-Arcady Meyer</i>	

Heart Rate Variability and the Acceleration Plethysmogram Signals Measured at Rest	266
<i>Mohamed Elgendi, Mirjam Jonkman, and Friso DeBoer</i>	
Emotional Face Perception in Healthy Subjects and Parkinson's Disease: An Effective Connectivity Study	278
<i>Elvis Lira da Silva, Gabriela Castellano, João Ricardo Sato, Ellison Fernando Cardoso, and Edson Amaro Jr.</i>	
Biometric Authentication with Electroencephalograms: Evaluation of Its Suitability Using Visual Evoked Potentials	290
<i>André Zúquete, Bruno Quintela, and João Paulo Silva Cunha</i>	
Part IV: Bioinformatics	
Reconstructing the Phylogenetic Relationships of the Cyclophyllidean Cestodes: A Case Study Using ITS2 rDNA and Sequence-Structure Alignment	309
<i>Veena Tandon, Devendra Kumar Biswal, Pramod Kumar Prasad, and Chenkual Malsawmtluangi</i>	
<i>ReHap</i> : A Framework for Single Individual Haplotyping from Next-Generation Sequencing Data.....	322
<i>F. Geraci and M. Pellegrini</i>	
Inference of Large Phylogenies Using Neighbour-Joining	334
<i>Martin Simonsen, Thomas Mailund, and Christian N.S. Pedersen</i>	
Prediction of Minimum Free Energy Structure for Simple Non-standard Pseudoknot	345
<i>Thomas K.F. Wong and S.M. Yiu</i>	
Intra- and Inter-Molecular Coevolution: The Case of HIV1 Protease and Reverse Transcriptase	356
<i>Patrick Boba, Philipp Weil, Franziska Hoffgaard, and Kay Hamacher</i>	
Structured Output Prediction of Novel Enzyme Function with Reaction Kernels	367
<i>Katja Astikainen, Liisa Holm, Esa Pitkänen, Sandor Szedmak, and Juho Rousu</i>	
A Parallel Algorithm for Counting Subgraphs in Complex Networks	380
<i>Pedro Ribeiro, Fernando Silva, and Luís Lopes</i>	
Efficient Searching for Motifs in DNA Sequences Using Position Weight Matrices	394
<i>Nikola Stojanovic</i>	
Author Index	407

Invited Papers

Personal Health: The New Paradigm to Make Sustainable the Health Care System

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Abstract. New technologies and innovation are leading a new paradigm in health care systems in order to face the growing demand and expectations in promoting and maintaining health and in disease prevention, treatment and care. ICT could have several applications in health scope (care, management, information and training) being an enabler for a personalized health system. RFID system, sensors, internet 2.0, electronic health records and ambient intelligence are some tools for catalyzing changes in health systems towards Personal Health.

Keywords: Personal health, e-Health, Telemedicine, ICT.

1 Introduction

In the last few years, health systems are facing a growing demand and expectations in promoting and maintaining health and in disease prevention, treatment and care. In order to confront such demand, new routes must be found to provide a greater number of complex patient-centered services. Experts indicate that a radical transformation of the health services supply process is required [1, 2]. This new approach, called personal health (pHealth), must be focused on health in a broader sense, not just on the treatment, incorporating information and communication technologies (ICT) and recognizing the influence of the patient as a service consumer. This implies a shift of paradigm in which ICT and patient empowerment will be drivers towards a sustainable and patient-centered health systems. Under the personal health, the patient, as a consumer of health services, acts more as a client, and therefore demands the corresponding rights and obligations; care task will be focused on promoting and preventing rather than treatment; finally, disease management will be converted towards a holistic concept of health and life management. In this new model, ICT is considered a tool towards personalized treatments, sustainable health services, better quality of service, closed loop relationship and evidence based medicine.

This chapter aims to approach to pHealth and ICT in the healthcare scope. The latest contributions in ICT as RFID, sensors, ambient intelligence (AmI), social health media - health 2.0- and barriers and initiatives to achieve interoperability between different information systems are other relevant aspects of the application of ICT in health that will be held during this chapter.

1.1 Telemedicine and Health

Telemedicine was defined by the World Health Organization (WHO) in 1997, as the delivery of healthcare services, where distance is a critical factor, by all healthcare professionals using information and communication technologies for the exchange of valid information for diagnosis, treatment and prevention of diseases and injuries, research and evaluation, and for the continuing education of healthcare providers, all in the interest of advancing the health of individuals and their communities [3].

According to this concept, telemedicine could have several applications in health scope. It can be useful to inform the population about health issues, for the training and information for healthcare professionals, to support for the continuum of care (management) and, finally, in purely assistance processes either for diagnosis, treatment and care.



Fig. 1. Telemedicine applications

e-Health policy in the EU is part of the 'Strategy Europe 2020' with the facing goal of achieving in the European Union, in 2010, an economy based on knowledge, competitive and dynamic, with improvements in employment and social cohesion. This plan of action includes measures to obtain a more efficient supply of services for citizens (e-government, e-health e-learning and e-commerce), intervening authorities, generating demand and promoting the creation of new networks. In 2006, the European Commission published a new strategy to accelerate the growth of the e-health market in Europe, 'Accelerating the Development of the e-health Market in Europe' [4] which deals with the elimination of several legal/regulatory barriers that restrict the development of the e-health.

2 New Paradigm for Health Care Systems

2.1 Disruptive Innovation

Disruptive innovation is a combination of technological advances and new business models that has the potential to transform the structure, organization, and performance of the healthcare system as a whole. Christensen [5] introduced the theory of disruptive innovation asserting that consumers could produce transformations of the prevailing business models by purchasing new products and services that were more affordable and accessible than those that had been traditionally offered. For the disruptive innovation, two drivers are needed: technological enablers and a disruptive business model that can profitably deliver these routine solutions to customers in affordable and convenient ways.

Technologies drivers for disruptive innovation in healthcare are advances in medical knowledge and advances in ICT. The ICT advances not only support the development of new techniques and devices. They also facilitate the codification, continuous updating, and diffusion of therapies and best-practice care protocols. ICT can make feasible the integration of a patient's health care data to provide real-time medical decision support to professional, as well as to patients and their families. ICT also enables the collection, integration, and analysis of data on the performance of the overall system and supports the use of many advanced systems design, analysis, and governance tools and methods to improve system performance.

Accelerating the development and application of ICT tools and techniques would make possible the design, analysis, and governance of new processes and systems throughout the health care system [6]. Disruptive innovation, applied to healthcare system, implies affordable, simple and network system, comparing with the current healthcare system with complex and high cost alternatives based in an oligarchic system.

2.2 Chronic Disease Challenge

Chronic disease management represents one of the greatest challenges for health in Europe. Growth rates of the adult population and aging projections in Spain only serve to highlight the need to implement comprehensive strategies for changing the routines and resources tackling chronic diseases. In the EU, currently 86% of deaths are attributed to chronic illness, accounting for 50-80% of the total expenditure on health, as appropriate. Under these conditions, reports the WHO, those health systems maintaining their current system of disease management will be facing a large problem and they cannot keep the current level of service for the growing number of people under chronic conditions.

Considering this challenge and trying to fit health services and needs, the patients' stratification by risk levels allows an adequate adaptation to the populations' healthcare needs, giving them the most appropriate response. The Kaiser Permanente pyramid [7, 8] has proved to be a very useful method for conceptualizing risk stratified groups of patients with long term conditions. The pyramid models long-term conditions by splitting the population into those who can care for themselves, individuals who need help to manage their diseases, and people who require more intensive