Computers in Biology and Medicine 88 (2017) 161–162

Contents lists available at ScienceDirect

Computers in Biology and Medicine

journal homepage: www.elsevier.com/locate/compbiomed

Editorial

Self-monitoring systems for personalised health-care and lifestyle surveillance

ARTICLE INFO

Keywords
Self-monitoring
Lifestyle
Health and wellbeing

ABSTRACT

The quality of life and individual well-being are universally recognised as key factors in disease prevention. In particular, lifestyle interventions are effective tools for reducing the risk and incidence of major illnesses, such as cardiovascular diseases and metabolic disorders. On the other hand, patient role is progressively shifting from being a passive recipient of care towards being a co-producer of her/his health. In this frame, novel devices and systems able to help individuals in self-evaluation are expected to play a crucial role. In this special issue we focus on innovative methodologies and technologies devoted to individual self-assessment, oriented both to healthy people to maintain their well-being, and to diseased persons to improve their care.

1. Introduction

The idea of promoting this special issue was largely stimulated by the activities we carried out in the European Community project *SEMEOTICONS*.[1] It was finalised to develop innovative self-monitoring technologies able to help people in cardio-metabolic disease prevention by acting on lifestyle so as to improve individual well-being.[2]

Well-being indicates the state or condition of being in good physical and mental health and a tight linkage exists between personal well-being and health. According to the World Health Organization, "health should be defined as a state of complete physical, mental and social well-being, and not merely as the absence of disease and infirmity" [4].

This is made even more evident by the role of lifestyle in illness risk. In particular, non-communicable diseases (NCD) which include among the other cardiovascular diseases, diabetes, and cancer, are leading causes of morbidity and mortality and impose a huge burden of socio-economic costs [5]. The risk of developing NCD can be reduced by acting on factors such as diet, physical activity, smoke and alcohol abuse as well as other noxious habits so that lifestyle interventions become a core factor in NCD prevention [5].

It is therefore not surprising that a growing number of persons is becoming more and more demanding about their wellness not only because they want to be fit but primarily because they want to stay well. In this view, we can safely affirm that technology has gained a strategic role: nowadays we live in a connected world always keeping our mobile devices handy, which favours the diffusions of dedicated devices, apps and services to monitor our lifestyle habits and advising us on how to improve it [6]. On the other hand, implementation of successful lifestyle interventions requires finely-tuned personalised plans. This, tough conceptually feasible through conventional resources of health services, is hardly practicable on a large scale and would require a complex organization with the cooperative intervention of a variety of health specialists (physicians, psychologists, dieticians, trainers). In this view, the development of novel instruments for individual self-assessment is a very promising path towards the implementation of modern and effective solutions in disease prevention. As a matter of fact, this well matches current paradigms of health self-management centred on individual awareness and empowerment.

2. In this issue

Friendliness and unobtrusiveness are key requirements of devices that should allow the collection of data in normal daily conditions and so catching pieces of information not easily accessible with standard medical tests that are usually obtained in lab settings. On the other hand, a naturalistic self-monitoring approach adds new difficulties to data acquisition and analysis: new methods are necessary to cope with non-controlled operational conditions still ensuring data reliability. Noise and artefact rejection along with ability to operate in presence of missing data should be considered standard requirement for data acquisition and processing methods.

The papers included in this issue provide significant examples of the challenging scientific problems to be faced when building effective self-monitoring solutions. At the same time, these works elucidates the innovative power of considered application fields. In particular they cover topics on data sources and acquisition modalities, data processing

[1] European Community Seventh Framework Programme (FP7/2013–2016), grant agreement number 611516.

[2] A description of the novel multi-sensing device so developed can be found in Henriquez et al. [1], while the papers [2,3] in this issue describe two specific researches conducted in the mentioned project.

http://dx.doi.org/10.1016/j.compbiomed.2017.07.011
Received 13 July 2017; Accepted 16 July 2017

and modelling.

Larsson et al. [2] describe the assessment of skin auto fluorescence by a multispectral camera-based imaging system. It allows self-assessing the skin accumulation of Advanced Glycation End-products (AGEs), an important marker of glucose metabolism related to diabetes as well as to other systemic diseases. The methodology makes AGE measurement available outside clinical settings.

The work by Pascali et al. [3] address the unobtrusive assessment of face morphology in 3D using data acquired with an inexpensive depth sensor. The approach shows a good agreement with well-established anthropometric indices and can be used to monitor lifestyle interventions on diet and physical activity in everyday life environments.

A very different, tough related topic, is faced in the paper by Farinella et al. [7] about image-based food recognition. In dietary plans, monitoring quality and quantity of food intake is a non-trivial but crucial task. Automatic food recognition is a very appealing alternative to filling time-consuming and often tedious questionaries. Automatic system can be a keys for a successful control of the quality of diet and body weight. In addition, the methodology may have interesting applications in food quality control.

Hypertension is one the main risk factors for developing cardiovascular diseases. All therapy plans for hypertension treatment requires the patients self-monitor their blood pressure (BP). For this reason, a plenty of commercial devices is available, many blood-pressure monitors being connected to mobile phones or tablets by ad hoc apps. Despite technological improvements, accuracy and reliability of measurements still remain a key factor for a useful BP self-monitoring. In view of this, Lee et al. [8] face this problem and propose a novel algorithm which combines Gaussian mixture model and bootstrapping for BP oscillometric measurements.

Paliakaitė et al. [9] focuses on the measurement of arterial stiffness, a biomechanical property of the cardiovascular system tightly connected to ageing and arteriosclerosis. Importantly, increased arterial stiffness is usually related to increased cardiovascular risk. In this manuscript authors describe a simple device based on a standard impedentiometric scale. It can be easily integrated in a normal exercise-bike and can be used to estimate the propagation delay of the blood volume pulse through the arterial tree. According to authors, such a delay is an interesting indicator of arterial stiffness useful for monitoring the impact of ageing on circulation.

The paper by Mesin [10] offers an interesting view on signal acquisition during self-monitoring activities. In facts, given the often unconventional setting of data acquisition, uniform sampling rate can prove inefficient and/or inaccurate, therefore using adaptive sampling schemes can significantly impact on monitoring activities implying long-term signal acquisition.

Self-monitoring approaches are open to intriguing applications and usages, many of which have not yet fully considered for practical usage. Nevertheless these can produce significant advances in care delivery and disease prevention. In this perspective, Varanini et al. [11] propose a new method to process fetal electrocardiogram framed in a self-monitoring perspective. As authors point out, the method can be used in a fully unsupervised way allowing the non invasive detection of fetal QRS.

Finally, the work by Di Palma et al. [12] deals with an extremely challenging task in psychiatry. In fact, they evaluate the autonomic response to sociocognitive tasks in children under treatment for autistic disorders. In this kind of monitoring, signal acquisition in a virtually naturalistic setting is required with a huge impact on system requirement.

The Guest Editors would like thank all the authors for their valuable contributions to this special issue and the Editor-in-Chief for hosting this initiative in Computers in Biology and Medicine. A special thank to Rukmani Krishnan and Joe Butler and to the whole editorial staff the at Elsevier for their competent and fruitful support.

Conflict of interest

None Declared.

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