Chapter XI
Towards Wearable Physiological Monitoring on a Mobile Phone

Nuria Oliver
Telefonica Research, Spain

Fernando Flores-Mangas
University of Toronto, Canada

Rodrigo de Oliveira
State University of Campinas, Brazil

ABSTRACT

In this chapter, we present our experience in using mobile phones as a platform for real-time physiological monitoring and analysis. In particular, we describe in detail the TripleBeat system, a research prototype that assists runners in achieving predefined exercise goals via musical feedback, a glanceable interface for increased personal awareness and a virtual competition. We believe that systems like TripleBeat will play an important role in assisting users towards healthier and more active lifestyles.

INTRODUCTION

Wearable health monitoring devices have attracted increasing interest in recent years, both in research and industry. The ability to continuously monitor physiological signals is of particular importance for the world’s increasingly aging and sedentary population, whose health has to be assessed regularly or monitored continuously.

It has been estimated that a third or more of the 78 million baby boomers and 34 million of their parents may be at risk for the development of devastating diseases including cardiovascular disease, stroke and cancer. Fortunately, presymp-
Towards Wearable Physiological Monitoring on a Mobile Phone

tomatic testing could save millions of these lives—and dollars—in the coming decades, according to experts. Wearable physiological monitoring devices are a critical component in preventive medicine where they will play an increasingly important role in the years to come.

In addition, a sedentary lifestyle is a major underlying cause of death, disease, and disability. Unfortunately, levels of inactivity are high—and keep increasing—in virtually all developed and developing countries. The World Health Organization (WHO)\(^1\) has estimated that 60 to 85% of all adults are sedentary or nearly so. Physical inactivity is the cause of approximately 2 million deaths every year. All causes of mortality are increased by physical inactivity. In particular, it doubles the risk of cardiovascular disease, type II diabetes, and obesity [Booth et al., 2002], [Flegal et al., 1998]. It also increases the risks of colon and breast cancer, high blood pressure, lipid disorders, osteoporosis, depression and anxiety. Chronic diseases are now the leading causes of death in the entire world, with the exception of sub-Saharan Africa. The WHO has estimated that the greatest public health problem in most countries in the world are unhealthy diets, caloric excess, inactivity, obesity and associated chronic diseases.

Fortunately, technology can play a very important role to address the reality of an aging, sedentary population. Wearable health monitoring devices will be at the core of this role, since they have the potential to: (1) support the practice of preventive medicine by enabling the detection of early signs of health deterioration; (2) allow daily, casual monitoring, which would lead to finding correlations between lifestyle and health [Oliver and Flores-Mangas, 2007]; (3) notify health care providers in critical situations; (4) enhance the sense of connectedness with loved ones by sharing real-time raw or interpreted physiological data; (5) promote and support an active lifestyle, i.e. a lifestyle that incorporates physical activities, sports and healthy life choices [Andrew et al., 2007], [cdc, 2005], [Oliver and Flores-Mangas, 2006a]; (6) bring sports conditioning into a new dimension, by providing detailed information about physiological signals under various exercise conditions; (7) bring healthcare to remote locations and developing countries, where cellular phones are pervasive and in some cases the only available communications device; and ultimately (8) transform health care by providing doctors with multi-sourced, real-time physiological data.

However, there are still technical, legal and societal obstacles that need to be tackled before these wearable devices are ready for general use. For example, these devices need to be non-intrusive, easy to use, comfortable to wear, efficient in power consumption, privacy compliant, with very low failure rates and high accuracy in triggering alarms, especially if used for diagnostic purposes.

In this chapter, we describe our experience in developing wearable real-time health monitoring systems on mobile phones. In particular, we have developed two prototypes that explore the impact of real-time physiological monitoring in the daily life of users: (1) HealthGear to monitor users while they are sleeping and automatically detect sleep apnea events; and (2) MPTrain/TripleBeat, a mobile phone-based system that encourages users to achieve specific exercise goals.

The HealthGear prototype has been described in detail elsewhere [Oliver and Flores-Mangas, 2007]. Hence, the focus of this chapter will be the MPTrain/TripleBeat\(^2\) prototype. TripleBeat allows users to establish healthy cardiovascular goals from high-level desires (e.g. lose fat); it provides real-time musical feedback that guides users during their workout; it creates a virtual competition to further motivate users, and it displays relevant information and recommendations for action in an easy-to-understand glanceable interface. Note that this chapter is based on research presented elsewhere [Oliver and Flores-Mangas, 2006a], [Oliver and Flores-Mangas, 2006b], [de Oliveira and Oliver, 2008]. The focus of the chapter is
34 more pages are available in the full version of this document, which may be purchased using the "Add to Cart" button on the product’s webpage: www.igi-global.com/chapter/towards-wearable-physiological-monitoring-mobile/26773?camid=4v1

This title is available in InfoSci-Books, InfoSci-Medical, Healthcare, and Life Sciences, Business-Technology-Solution, Communications, Social Science, and Healthcare, InfoSci-Select, InfoSci-Select. Recommend this product to your librarian: www.igi-global.com/e-resources/library-recommendation/?id=1

Related Content

Current Telehealth Applications in Telemedicine
www.igi-global.com/chapter/current-telehealth-applications-telemedicine/20584?camid=4v1a

A Measure to Detect Sleep Onset Using Statistical Analysis of Spike Rhythmicity
www.igi-global.com/article/a-measure-to-detect-sleep-onset-using-statistical-analysis-of-spike-rhythmicity/115883?camid=4v1a

Low Noise EEG Amplifier Board for Low Cost Wearable BCI Devices
www.igi-global.com/article/low-noise-eeg-amplifier-board-for-low-cost-wearable-bci-devices/170459?camid=4v1a

Demographic Differences in Telehealth Policy Outcomes
Mary Schmeida and Ramona McNeal (2009). *Handbook of Research on Distributed Medical Informatics and E-Health* (pp. 500-508).
www.igi-global.com/chapter/demographic-differences-telehealth-policy-outcomes/19957?camid=4v1a