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Exergaming on Mobile Devices

Introduction

Physical inactivity is a serious health problem in modern society (Daley 2009). In sedentary lifestyles, active computer fitness games can play an important role to increase people's quality of health. Playing exergames can directly integrate vital, physical and kinematic parameters into the gameplay and enhance the motivation to be more sustainable physical active in a playful way (Armstrong 2007), (Göbel et al. 2010). In contrast to many stationary exergaming systems like the Nintendo Wii Fit or the Sony Kinect Sports, recent approaches include mobile devices like tablets or smartphones with small wireless sensor nodes attached to the body or sports equipment (Kugler et al. 2010). The purpose of our work is to present an approach to enable exergaming with Body Sensor Networks and mobile devices.

Methods

Our system approach consists of two hardware components: one or more wireless SHIMMER™ (McGrath et al. 2009) sensor nodes as data recording units for physiological (EMG, ECG, GSR) and kinematic (acceleration, gyroscope, magnetometer) data and a mobile device as data processing unit based on ANDROID™. All sensors are accessible through the mobile sensor framework (Kugler et al. 2011), which allows rapid development of different applications (Kugler et al. 2012). Firstly, data is transmitted to the mobile device. Second, this data is interpreted as user input for applications and games. Finally, the mobile device controls the gameplay or the application and gives feedback about game progress and exercise parameters.

Applications

Subsequently, we present a selection of three exergames (Fig. 1 from left to right), whereat the last is described in more detail: *FlexiFit* is an exergame using a Flexibar and a sensor attached to the wrist. Different exercises can be performed and parameters like frequency or steadiness are displayed for feedback. The second application, *KeepUp*, counts how often a user is able to keep up a ball with his feet. The next application, *SensorSnake*, demonstrates an EMG-controlled snake game. The left-right movement of the snake is derived from muscle contractions of both forearms. The processing is shown in Fig.1 right. Primarily, the raw EMG signal (1) is squared to calculate an energy signal (2). Then, a moving average filter is used to eliminate outliers (3). Last, a user dependent threshold (3) is set. Whenever the signal is above this threshold, an arm movement is detected (4).

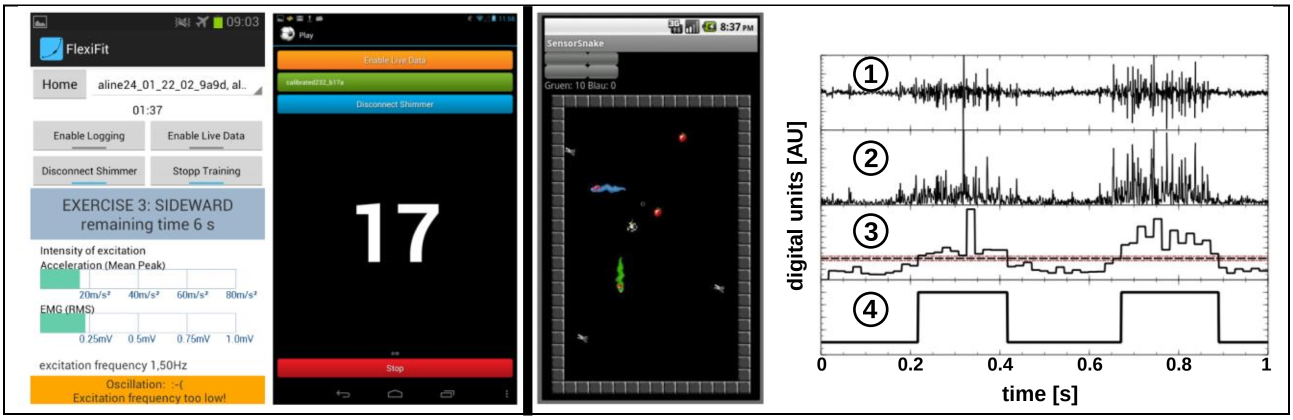

Fig.1: Examples for exergames (left to right): *FlexiFit*, *KeepUp* and *SensorSnake* with its data processing: raw signal (1), energy calculation (2), moving average filter with threshold (3) and results (4).

Summary and Outlook

In this project we presented our approach to enable exergaming on ANDROID™ based mobile devices using wireless SHIMMER™ sensor nodes. We described the process to develop different applications, showed example exergames and described the data processing for an EMG-controlled snake game in detail. In the future this setup can be used to improve the health of physically inactive people by playing exergames and become more sustainable physically active.

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References

Daley, J. A. (2009). Can Exergaming Contribute to Improving Physical Activity Levels and Health Outcomes in Children? PEDIATRICS, 124 (2), 763-771.

Armstrong S. (2007). Wireless connectivity for health and sports monitoring: a review. British Journal of Sports Medicine, 41, 285-289.

Göbel S., Hardy S, Wendel V., Mehm F. & Steinmetz R. (2010). Serious Games for Health — Personalized Exergames. In Proc. of the ACM Multimedia 2010, Florence, 1663-1666.

Kugler, P., Jensen, U., Eskofier, B. & Hornegger, J. (2010). Feedback-Training mit tragbaren Sensor-Netzwerken. In Proc. of the INFORMATIK 2010, Leipzig, 3-8.

McGrath, M. & Dishongh, T. (2009). A Common Personal Health Research Platform — SHIMMER™ and BioMOBIUS™. Intel Technology Journal, 13 (3), 122–147.

Kugler, P., Schuldhaus, D., Jensen, U. & Eskofier, B. (2011). Mobile Recording System for Sport Applications. In Proc. of the IACSS 2011, Shanghai, 67–70.

Kugler, P., Jensen, U. & Eskofier, B. (2012). Recording and Analysis of Biosignals on Mobile Devices. In Proc. of Sportinformatik 2012, Constance, 182–187