

New wireless portable physiology monitor for psychophysiology research

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Introduction

Several research groups at the Leiden University Faculty of Social Sciences conduct psychophysiological research. In this type of research, physiological measurements are taken from participants during psychological research. Researchers may simultaneously measure the electrical activity of the heart with ECG, Galvanic Skin Response (GSR) measures the electrical impedance of the skin, Breathing rate, and the chest cavity impedance using external sensors with Impedance cardiogram (ICG). These signals represent different ways to measure the physiological state of a person and can be influenced by levels of concentration and arousal.

Currently, off-the-shelf equipment is available to measure physiological responses. However, this equipment has several drawbacks. Most devices do not have online display capabilities. This may result in unnoticed bad signal integrity if electrodes become disconnected. Moreover, some of these devices transmit signals via an analog radio link to the base station, where it is then digitized. This leaves the signal vulnerable to degradation during the analog radio transmission.

Development of an improved Wireless Physiology Monitor

I investigated the possibility to use commercially available personal digital assistants (PDAs) as an alternative platform for such devices. Currently, commercially available PDAs combine processing power, displaying capabilities, and digital wireless connectivity. They provide an excellent platform for taking measurements with on-screen signal visualization and digital wireless data transfer at a low cost.

The system I developed contains an online graphical display and digital transmission of the full signals. This means that researchers can check the signal integrity on the PDA screen and store the entire true waveforms of the signals on both the PDA and the base station for later offline analysis. To facilitate offline analysis, researchers can synchronize experiments with data because the system allows them to place and store markers with the data.

Wireless capabilities

The system makes use of the WiFi network capabilities to send the acquired data to a PC based client application. This digital wireless communication does not introduce any data degradation as opposed to analog data transmission. If the digital wireless connection is lost, the data is logged to memory until the connection is restored.

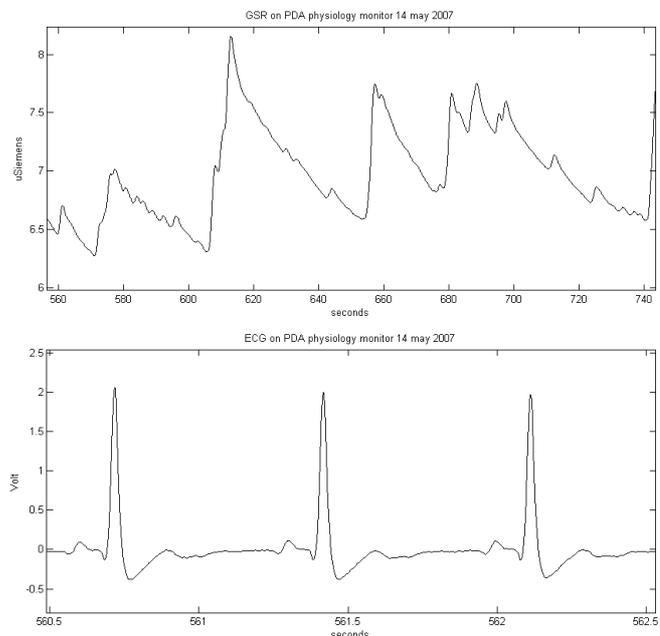


Figure 1. Left side: Photo of the PDA based Physiology monitor; Right side: Examples of high quality data acquired with the PDA based Physiology monitor

Conclusion and future work

The small ambulant physiological monitoring system has several advantages over existing equipment. The portable device features:

- Direct online display of the measured ECG, GSR data
- 2 additional analog channels free for custom use
- Onboard logging to file
- Wireless digital transmission of the full data stream to a host computer

- Lossless reconnect capability if the wireless link is lost
- Considerable cost saving over comparable systems, which do not contain online graphical displays or digital telemetry of the signals being measured

After initial tests we plan to use multiple devices in different departments of our university. Our future research may focus more on adding online and offline data analysis tools to the software application.