

Example health/medical research use (for adult sleep/sleepiness) of Movesense

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Movesense research possibilities

- Researchers want something customizable and cost effective
- Originally (still) interested in data logging (actigraphy)
- Streaming data possibilities
- Device programming for reaction time task (Biohacker Summit 2017)
- Advertisement packets (Junction hack demo 2017 with Kristian Lukander)
- Using standard GATT services (HR) to transfer data to PC
- Psychomotoric Vigilance Task, Sleep meetings: Baltimore 2018-06
- As an additional activity sensor, Sleep meeting: Basel 2018-09
- Using as ExG sensors, blinks and eye movements, sleep



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Reaction Time Tasks with Low-cost, General-purpose, Coin-size Movement Sensor

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Introduction: Psychomotoric Vigilance Task (PVT) is the gold standard for assessing effects of sleep deprivation on **sustained attention**. It has been implemented in various software running on computers, tablets, and phones, and **device-specific touch latencies** and screen characteristics are known to affect results in longitudinal measurements. We evaluated the potential of a low cost, general-purpose, coin-size (10 g/0.35 oz), 9-axes movement, temperature, heart rate, and ExG sensor (**www.movesense.com** by Suunto Oy, a subsidiary of Amer Sports Corporation) for performing a **PVT-type reaction time task**.



Figure 1. Holding device in 3D printed case showing stimulus led.

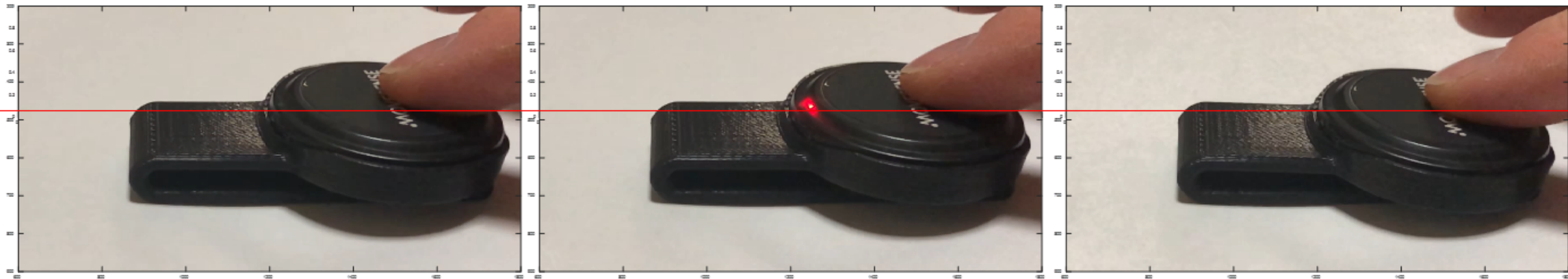


Figure 2. Small rotation detected with 416 Hz gyroscope and verified with 240 Hz video. Due to 8 samples buffered output stimulus stays on extra 0-19 ms after detected rotation.

Methods: The device was held on hand between the thumb and the index finger. The sensor has a red led, which was used as the stimulus. Pressing the sensor in 3D case with the other hand's thumb and index finger **resulted in a small rotation detectable with the gyroscope of the device.** Custom embedded software (C++) measured this reaction time and transferred it over bluetooth to a device (PC, Android or iPhone) for display and storage.

Conclusion: Dedicated hardware and embedded software enables accurate reaction time measurements independent of computer, tablet, or phone model. The same hardware can be used for **actigraphy**, general movement sensing, heart rate sensing, and for recording ExG. The device also has a memory buffer for storing data, enabling PVT-type reaction times without any additional devices.



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Topic: 12 Basic sleep science - Instrumentation and methodology (basic sleep science)

Title: Activity monitor setup with two sensors

UNDER REVIEW

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Text: **Objectives / Introduction:** Actigraphy is a common technique for sleep-wake classification and for activity monitoring. Usually for sleep-wake classification, a monitor is placed on the non-dominant wrist. It would be beneficial to have an additional sensor on e.g. the trunk, indicating body position and movement. Using two standard activity monitors results in a problem of synchronizing the signals in long recordings. Use of two devices also doubles the cost of the setup. We combined a standard clinical actigraph monitor and a low-cost movement sensor in a wireless setup.

Methods: ActiGraph GT9X and wGT3X devices (ActiGraph, LLC) have the possibility to store heart rate (HR) from heart rate monitors over Bluetooth. We custom programmed a low-cost, general-purpose, coin-size movement sensor Movesense (Suunto Oy, a subsidiary of Amer Sports Corporation) to transmit position information encoded as HR information. Movesense integrates 9-DOF movement, temperature, heart rate, and ExG sensors with a built-in memory. In this study, the Movesense device single axis acceleration values -1.27 g to 1.27 g were transformed and transmitted as 1-255 bpm HR to the ActiGraph monitor and stored synchronously with monitor activity once per second.

Results: We evaluated the setup by connecting the two sensors together and recorded for a period of two weeks. The sensors' corresponding acceleration values were identical to resolution of sensor.

Conclusions: With the simple addition of a low-cost movement sensor we created an activity monitor setup with two synchronized signals from different body locations. One sensor provides standard activity monitor data and the other low-cost sensor provides additional information about body position. Instead of body position sensor, the sensor can be programmed to provide e.g. activity counts when placed on the waist, information about standing when placed on the thigh, periodic leg movements when placed on the ankle, or possibly even breathing movement when placed over the thorax.

Disclosure: Nothing to disclose

Custom 3D cases

- Technician Pasi Polvi, Engineer Kristian Lukander
- Instead of ECG also EOG, ExG?

ECG

Serial: 174630000523

Sw version: 1.0.2

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Blinks detected

