

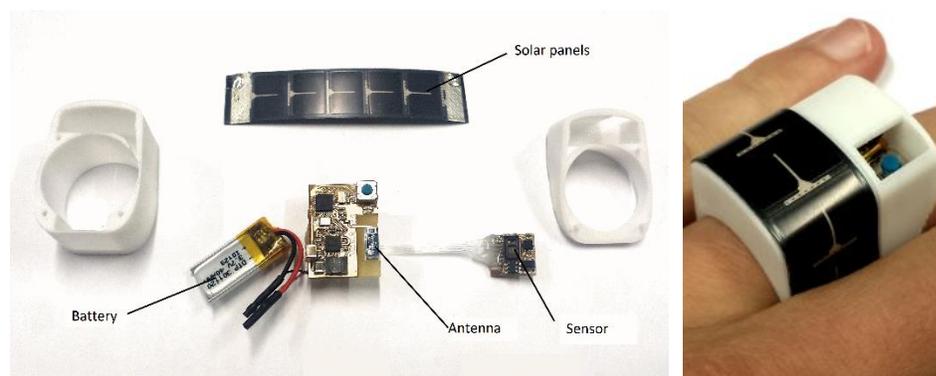
SmartRing

Project Description:

Build the next generation of wearables during this project! In 2016 we developed a self-powering ring oximeter that measures the heart rate and the oxygen saturation in the blood using a NIRS sensor, integrated in a wearable ring. It worked pretty well: detected holding the breath, output the current pulse rate and the oxygenation via Bluetooth onto an Android app and managed to recharge the battery. Basic features:

- Bluetooth communications with a smartphone for data extraction
- A solar panel connected to a COTS energy harvester chip to run the device without charging the battery
- A low power microcontroller to compute the (pulse/oxygenation) algorithm on-board the device
- An accelerometer for motion tracking

Now we would like to upgrade the system by adding advanced machine learning capabilities for sensor fusion and replace the harvester with a more efficient solution.



We are searching for motivated students in any of the following domains:

- **Energy harvesting: Get an insight into state-of-the-art energy harvesting chips!**
Study the mechanisms of CSEM's state-of-the-art energy-harvesting chip (developed in-house) and develop an efficient control algorithm (running on the chip's controller) to extract as much power as possible from a set of attached solar cells. This includes intelligent adaption to changing lighting conditions, variable light distributions over the set of cells and adaptive dynamic voltage and frequency scaling (ADVFS) within the chip. In the end, upgrade the system with your energy harvesting solution.
- **Machine learning: Make the device smarter by adding machine learning (ML) capabilities!**
Acquire data, learn from them and implement a system that is more robust and more intelligent. This can include taking motion-data from the accelerometer into account to compensate for motion-artefacts in the pulse monitoring, improve the algorithm by using ML systems (e.g. neural networks)

Prerequisites:

- Some experience in programming microcontrollers and developing PCBs
- Motivation to build a real systems

Detailed Task Description:

A detailed task description will be worked out right before the project, taking the student's interests and capabilities into account.

Organizational:

- Supervision: Petar Jokic (petar.jokic@csem.ch), Michele Magno (michele.magno@iis.ee.ethz.ch)
- Place of work: The project will be carried out at CSEM Zurich (in Technopark, next to Hardbrücke)
- Professor: Prof. Luca Benini