Zurich University
of Applied Sciences

School of Engineering

InES Institute of Embedded Systems

Energy Self-Sufficient Activity Monitoring on Chair with Dynamic Seating Plate

Diplomand/in
Andreas Stahel

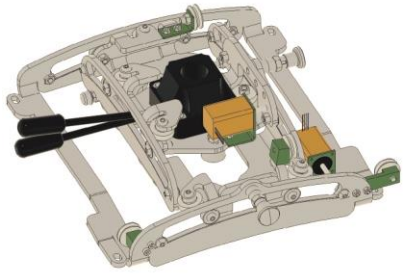
Dozent/in
Juan-Mario Gruber

In this master's thesis, an office chair is modified to collect measurement values with the help of a sensor and transmit them to a receiver. It is a stool with a movable seat developed at the ZHAW, which is intended to reduce static loads while sitting. The embedded system is powered by energy harvesting. The movement of the seat serves as the energy source. An energy harvesting system is built that uses generators to convert the mechanical energy into electrical energy and makes it available to the embedded system.

First, a concept for the system is created based on preliminary research. Then, mechanical modifications are made to the stool. Test measurements are made to evaluate generators that can be considered for the energy harvesting system. Afterwards, harvesting electronics are designed and built to ensure a stable energy supply for the embedded system.

Modified chair with added electronics visible on the right side. The electronics contain an accelerometer to detect the movement of the seating plate.

The collected energy is sufficient to run the embedded system completely self-sufficient. The consumption is about 0.4 mW in standard mode. Depending on how often data is transmitted, the consumption can increase up to 1.2 mW. The yield of the energy harvesting system strongly depends on the user's activity. With moderate movement, it is a few milliwatts. During intense movement, it averages 30 mW and can peak above 100 mW. A supercapacitor serves as energy storage to bridge phases with little movement. With the storage capacitor fully charged and no further energy input, the embedded system can remain active for over four and a half hours until the capacitor is discharged.



3D model of the existing mechanism with added generators (yellow) and additional parts (green). The movement of the mechanism is transferred to the generators with a rope.

The sensor measures the movement of the seat and allows statements to be made about its position and the user's activity. The collected data is transmitted to a receiver via Bluetooth Advertising. There the data is processed and displayed via a serial interface on a console on the Computer. The receiver has different operating modes. Along with displaying the received data, the position of the seat can also be displayed graphically. A training program can instruct the user to perform a particular movement and check the execution. In addition, a game has been implemented that the user can control with his movement on the stool. Furthermore, the receiver can monitor the user's activity and remind him with a message if he does not move enough.