Miniature Data Logger

Degree programme: BSc in Electrical- and Communication Engineering | Specialisation: Embedded Systems
Thesis advisors: Prof. Dr. Torsten Mähne, Prof. Ivo Oesch
Expert: Michael Held
External project partner: ETEL S.A., Môtiers

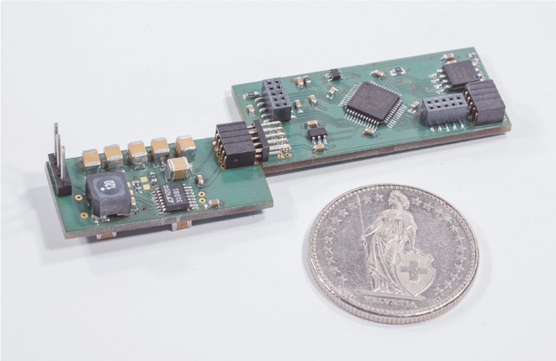
One of the top aims of every company is the continuous improvement of the quality of their products. In order to deeply understand the new challenges imposed by the market, it is important to know the working conditions experienced by a product during operation. With the development of this miniature data logger, the company ETEL S.A. gets a conceptual design and a prototype to draw conclusions about the operating conditions a device was confronted with. 1

Context of this work

The company ETEL S.A. provides drive solutions ranging from high-end motion systems with nanometre precision to industrial applications requiring high torque/force. To improve their products, ETEL would like to know the operating conditions those products were confronted with. They wish for a data logger, which is able to measure and store different operating parameters during the live time of the product.
The data logger shall be placed in a large variety of devices. Therefore, the device has to work fully autonomous without any connection to the outside. The big difficulties in the development of the miniature data logger are the hard environmental conditions, like the maximal temperature of 130 °C or strong electromagnetic fields from motor coils, and the long time of at least 10 years the data logger has to work autonomously.

Concept and realisation

It is not possible to power the data logger from outside the motor over wires. Therefore, an energy harvesting method, which works inside the motor has to be found. Using a thermoelectric generator (TEG) as energy source to exploit the significant temperature difference between the motor coil and the motor case turned out to be most promising. Therefore, different Peltier/Seebeck modules were evaluated and tested in a lab set up, which simulated the environment inside the motor as good as possible. The harvested energy has to be processed to adjust the voltage level to the needs of the powered circuit. Two suitable power management ICs were selected for further tests and integrated to this end onto two self-designed PCBs. In parallel, different data storage devices were evaluated and again two types were selected for integration with a microcontroller and sensors onto a second set of two PCBs, which can be freely combined with the first set of two PCBs for the power supply. The microcontroller communicates with the sensors, stores the data in the non-volatile memory, and sends the data on request over an interface to a computer. The software for the microcontroller was completely developed in this thesis. With FreeRTOS as a basis, the software is modular, so that follow-up projects can modify or add modules to improve the whole system.



Power management PCB on the left and data acquisition PCB on the right, compared with a 2 CHF coin.

Outlook

With this bachelor thesis, the foundation for a miniature data logger has been laid. It is shown, that a realisation of a device with an operation autonomy of 10 years inside a motor is basically possible. Not realized is the circuit to power the device during the data recovering and the read out of the data. The data logger will be embedded inside the motor potting. Therefore, a wireless solution for the power and data transmission is needed for the lab. Those two tasks and the miniaturisation of the developed PCBs have to be done in follow-up projects.

Alexander Michael Büchel
buechel73@gmail.com

David Simon Wegmüller