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Energy harvesting powered bicycle computer

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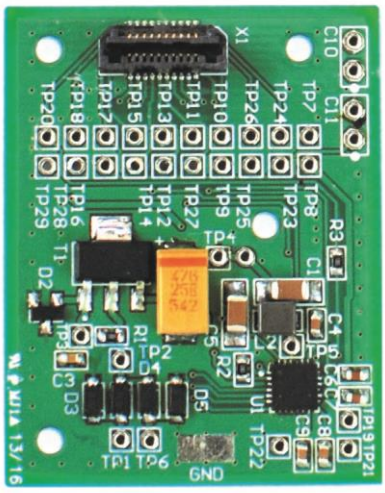
The exchange of data between devices - commonly referred to as "Internet of things" - should be made accessible to cyclists. The mobile device should start to work at a cycling speed of 10km/h, transmitting data through the Bluetooth Low Energy (BLE) protocol. The task is based on a feasibility study which handles the energy management through the chip EM8500. A "SensorTag" - available on Texas Instruments Simple Link devices - is responsible for sending the data. This board contains a wireless MCU and a low power Cortex M3.

The goal of the task was the development of a miniaturised board, which should not be bigger than the utilized TI-SensorTag while adjusting the energy storage, energy management and the power consumption of the code. The finished product contains the hardware and a user friendly Android application. The "app" allows adjusting the sensor readouts and displays a tachometer and a speedometer showing the current speed, which is based on the radius of the wheel.

At the start, a feasibility study was conducted. The feasibility study version showed promise for enough energy being produced at speeds over 45km/h.

After improving the energy harvest we were able to generate 20 uW at 10km/h. The energy management of the EM8500-Chip and the firmware of the TI-SensorTag were then completely rewritten. The threshold of the energy management is based on the MPP of the harvester and the goal is to send constant BLE-data at 10km/h. The firmware of the TI-SensorTag uses sleep functions to reduce the energy requirements.

The prototype is a configurable BLE-application, which sends speed, pressure, temperature and air moisture data in 1.5 minute intervals at 10km/h. From 20km/h onward, the data is sent every 20 seconds and over 45km/h the data is sent continuously.



The PCB above shows the harvester circuit with the energy management. The connector on the top side is the interface to the TI-SensorTag, which is used to send data to an android application.