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School of Engineering

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Energy self-sufficient, smart Shoe

In this bachelor thesis, an autarkic system is built into a shoe sole. The energy needed to run the system is collected with a Piezo-Buzzer which is deformed by the step motion of the wearer. It then produces energy using the piezoelectric effect. The feasibility was proven by the previous project thesis «Sensorik im Turnschuh». The results of this project thesis are refined and improved.

The energy is transformed with a harvester circuit and buffered in multiple storage capacitors. This harvester circuit is extensively tested in search for an alternative solution to the circuit used in the project thesis. The examined solutions turned out to be not practicable and were dismissed. Instead the solution from the project thesis was pursued and optimized.

A nRF52832 microcontroller evaluates four pressure sensors, which are distributed on the shoe sole. This data is used to calculate a profile that allows a statement on the load distribution. Additionally, the microcontroller collects data about the number of steps and the current amount of stored energy.

This data is transmitted to a smartphone using Bluetooth Low Energy (BLE) in advertising mode. There the data is processed and displayed. This includes a textual as well as a graphical presentation of the data of the force sensors.

The complete system was tested and examined with regard to the energy balance. It turned out that the operation of the system is possible with the Piezo-Buzzer as an energy source, as already proven in the project thesis. However, the startup of the microcontroller is still difficult. In comparison with the previous project thesis progress was made by implementing a startup delay, a defined startup procedure and an optimized energy storage system.
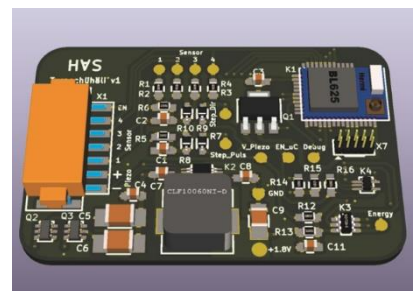

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Overview of the finished product. On the top, the sole with the built-in sensors and the circuit board is visible. On the bottom, the shoe with the cavity in the heel is shown.

3D Model of the printed circuit board with the nRF52832 microcontroller that was produced and built into the shoe.