LELEC2811 - Activity monitoring
Context and conditioning chain specifications

Context

In this mini-project, your customer is a manufacturer of wearable devices who is specialized in the monitoring of human activity. More specifically, his objective is to develop a prototype to distinguish between different types of motions such as walking, running and jumping. To do so, this prototype will rely on a sensor placed inside a shoe, as shown in Fig. 1a, different motions leading to different sensor responses, as highlighted in Figs. 1b-1d. A piezoelectric transducer is selected as it converts the strain of the piezoelectric material due to the motion into electrical charges, which will then be conditioned by the sensor conditioning chain.

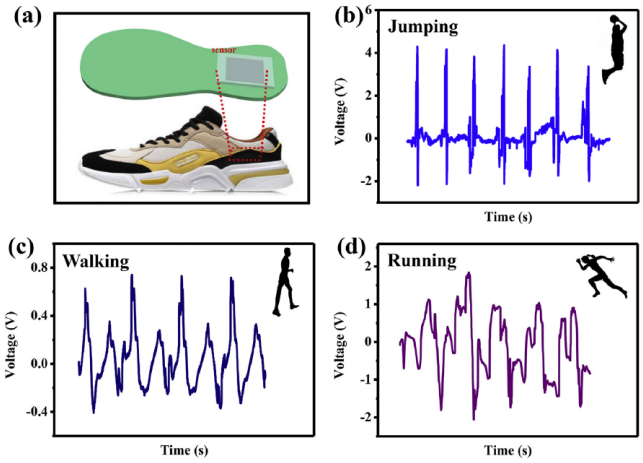

Figure 1: (a) A piezoelectric sensor is placed inside a shoe to monitor human activity. (b)-(d) Motions such as jumping, walking and running lead to different sensor responses. Used with the courtesy of [1].

Specifications

The conditioning chain that you are asked to design must be able to operate continuously and will condition the charges generated by the piezoelectric sensor into a readable analog voltage. This voltage will then be digitized by an ADC at a sampling frequency of 1 kHz. In addition, the conditioning chain must respect the following specifications:

- Pressure range: 5 to 50 kPa;
- Signal bandwidth: 0.5 to 40 Hz;
- Supply voltage: $\leq$ 3.3 V;
- Ergonomy: Can be placed inside a shoe without discomfort.

Available raw sensors

Four different raw sensors can be used to develop the prototype:

1. The MiniSense 100 vibration sensor;
2. **The LDTx-028K vibration sensor/switch;**
3. A macro fiber composite (MFC);
4. A piezoelectric diaphragm from muRata.

References

[1] Y. Yang, H. Pan, G. Xie, Y. Jiang, C. Chen, Y. Su, Y. Wang and H. Tai, "Flexible piezoelectric pressure sensor based on polydopamine-modified $BaTiO_3$/PVDF composite film for human motion monitoring", *Sensors and Actuators A: Physical*, vol. 301, p. 111789, Dec. 2019.