CS4222/CS5422 Semester 2, 2022/2023

Tutorial for Week 5 (February 6th, 2023)

Question 1: What sensors does your phone or wearable device (such as a Fitbit) use to estimate the number of steps you have taken? How does it perform step-counting?

Answer 1:

Accelerometers or other similar motion sensors are used to estimate the number of steps taken. Often, an IMU (which can be considered an accelerometer with a gyroscope) can also be used for this purpose. Modern devices often utilize a combination of sensors to accurately estimate the number of steps taken.

To perform step counting, wearable devices or smartphones analyse the motion of the device, including the frequency and intensity of the motion. These parameters are then processed using machine learning algorithms or similar techniques to infer the type of motion and determine if it corresponds to a step.

Question 2:

Please list the sensor(s) you plan to use to support the following application scenarios.

Answer 2:

Detecting metallic objects that are buried in the soil

We will use a magnetometer. Buried objects can cause changes in the magnetic field.

Detecting blood oxygen levels on a wearable device

We commonly use pulse oximeter to measure oxygen level present in the blood

Determining water level in a tank situated on top of a building

We commonly use ultrasound sensor to measure the level of liquid.

Generate a 3D mapping of historical structures

We commonly use LIDAR to generate 3D mapping of historical structures

Question 3:

Molex produces thin-film/flexible batteries rated capacity of 10 mAH and voltage 3V.

a. Can you calculate the battery life when powering the following components of IoT devices exclusively (no other components are being powered)?

Answer a)

- BME 280: Pressure, Humidity, Temperature Sensor (Sampling at 1Hz), current 3.6 microamperes

  Lifespan: 10*1000/3.6 = 2777.78 hours

- ADXL 337: Accelerometer, supply current 300 microamperes

  Lifespan: 10*1000/300 = 33.33 hours

- OPT 101: Light sensor, current 120 microamperes

  Lifespan: 10*1000/120 = 83.33 hours

- HM01B01: Camera, current approx. 1500 microamperes

  Lifespan: 10*1000/1500 = 6.67 hours

b. How can you extend the battery life to a much longer duration than what was calculated in Part 3(a)? How do the characteristics of the application assist in making this decision?

We do not need to continuously sample the sensor data. In the previous example, we kept the sensor active at all times. However, this is not necessarily an optimal scenario. For instance, we may only need to take an image from the camera every 10 minutes. Similarly, the ambient temperature values might not change frequently, and therefore, sampling every hour could be sufficient. This can result in a significant improvement in battery life.