COMP 417 Assignment 4
Arduino Step Counter with Accelerometer
Due: Dec 2, 11:59pm

1 Objectives

Design and implement a step counter using an Arduino board and an accelerometer sensor. This assignment is divided into two parts, focusing on data processing techniques to count steps during a walking scenario.

2 Data Processing with Moving Average (70%):

1. Install the required libraries for your Arduino setup and ensure that you can successfully print accelerometer data.

2. Perform a walking scenario, collect data, and save it. Note, you will need to report the plots of the raw data.

3. Apply a moving average window to the data to obtain smoother data.

4. Find appropriate thresholds to detect the starting and ending points of a step during walking.

5. Turn on a flash LED for each detected step. Conduct tests to evaluate the accuracy of your step counter. Note that perfection is not required; some minor inaccuracies are acceptable.

6. Finalize your step counter by printing the counted steps for a few walking scenarios.

3 Data Processing with a Recursive Filtering Technique (30% + 20% Bonus):

In this part you will be using the following formula to modify each data point with a smoothed version:

$$\hat{x}(k) = \hat{x}(k-1) + L(x(k) - \hat{x}(t-1)) \tag{1}$$

In this context, $\hat{x}(k)$ represents the smoothed data point at time k, while $x(k)$ denotes the corresponding raw data point. Lastly, L is a gain in $(0,1)$.

1. Implement a filtering technique as described using the formula provided for obtaining filtered data.

2. Apply this technique to the recorded measurements with a gain (L) set to 0.2. Note, you can also deploy the recursive filter and conduct a new walking scenario while recording both raw and smoothed data points.

3. Find appropriate thresholds on the filtered data and use them to count the steps.

4. (Bonus) Repeat step 2 for two additional k values: 0.5 and 0.8, and explain the differences you observe.

4 Things to submit

Submit a report detailing your Arduino setup, data collection, data processing techniques, and results. Include all relevant code and documentation. In brief, you need to submit the following items:

- Record and report raw data from the accelerometer for a walking scenario, including data from at least five steps.

- Apply a moving average window to the raw data, report the smoothed data, and the thresholds to detect the starting and ending points of a step.

- Report the number of steps counted and compare it to the actual number of steps taken during the walking scenario.

- For Part 2, apply the filtering technique with k = 0.2 and report the smoothed data plot, along with the applied thresholds.

- (Bonus) Repeat step 4 for k values of 0.5 and 0.8 and explain the differences observed in the results.

This assignment will test your understanding of Arduino programming, data processing, and problem-solving skills. Enjoy experimenting and learning during this practical exercise.