ECE/CS 498rc

Programming Assignment 1: Exploring Multi-Modal Sensing on Smartphones
Due: 6th March 2019

1 Objective

The goal of this assignment is to get familiar with the smartphone's multi-modal sensing capability. This assignment will introduce you to the smartphone's development environment through real life coding exercise.

Students can work on this assignment in a team of two.

2 Programming Assignment

There are four stages of this assignment. Make sure to read the full assignment before starting.

2.1 Stage 1

Write a program to collect sensor readings. The sensors which need to be considered for this assignment are (1) accelerometer, (2) gyroscope, (3) magnetic field, and (4) light sensor. Your program should be able to gather the raw sensor readings in real time and store them in a csv file in the smartphone. The csv file will store the following data columns sequentially.

- Timestamp (in milliseconds from start of program)
- Accel_x
- Accel_y
- Accel_z
- Gyro_x
- Gyro_y
- Gyro_z
- Mag_x
- Mag_y
- Mag_z
- Light intensity

2.2 Stage 2

Collect all the sensor data using the program developed in Stage 1 at the fastest rate available. Hold the mobile device (i.e. smartphone or tablet) on the palm of your hand keeping the screen facing up and directing the phone's y-axis towards the direction that you are facing.
You will store your csv file for each distinct activity separately. The distinct activities include: WALKING, RUNNING, IDLE, STAIRS, and JUMPING. In other words, whether you are walking, idle, or going up stairs, the sensor readings during each distinct activity should be stored in a separate file. After the end of each activity, you will store a csv file in the following format: <LABEL>_dd-mm-yy_hh:mm:ss_<DISTANCE>.csv. Insert the activity performed (all CAPSLOCK) in the place of "<LABEL>," and the distance traversed in the place of "<DISTANCE>" in cm units (in lowercase) - when idle, the distance would be 0cm. Finally, the "hh:mm:ss" should be stored in 24hr format, and the timestamp should reflect the time the activity was started. The "Timestamp" column stored in the csv file should start counting from the initial timestamp. Some example file names are: RUNNING_04-02-16_14:11:02_100cm.csv and IDLE_04-02-16_14:13:34_0cm.csv.

2.3 Stage 3

Count your footsteps from sensor readings collected from Stages 1 and 2. Design and implement an algorithm which can count the footsteps accurately.

2.4 Stage 4

Here, you will analyze sensor patterns from various activities, which could be eventually used for classification. Divide each of the sensor trace into 0.2 second intervals. For each interval, compute the following features – Mean, Median, Max, Zero-crossings and Variance. Pick three features and plot a 3d scatter plot of co-ordinates (feature1, feature2, feature3) from different activities. Pick the three best features that can separate the activities visually in the 3d plot. In other words, the 3d points corresponding to JUMPING and those corresponding to IDLING could appear as visually distinct cluster in the 3d graph.

2.5 Stage 5 (Optional. Complete for extra credit)

In addition to saving your readings in a csv file, stream your readings in real-time to a machine for some data visualization using Matlab (or some other tool). Plot the spectral energy graph of your acceleromter sensor readings. Also plot the 3d graph from the previous stage for real time data. Explain your graphs and make interesting observations. Also display step count along with the visualization graphs. Extra credit will be given for creative visualizations of sensor readings and what they signify.

3 What to submit

Submit one zipped folder that includes the mentioned data files and plots for each 'stage' separately. The zipped folder should also include the codes used in this assignment and a README file.

Note: Please use only fundamental sensors and not derived sensors (e.g., do not use the step counter sensor directly, but you may use the barometer sensor if you find it useful). Your code will be checked for which sensors you have used.