CPE477/ECG677 – Embedded Security & Machine Learning

Design Assignment 1

DO NOT REMOVE THIS PAGE DURING SUBMISSION:

Name: Nicolas Evangelista

Group-Partner Name: Darriel Lai

Email: evangn1@unlv.nevada.edu

Github Repository link (root): https://github.com/NicolasE04/yeahsure.git

YouTube Playlist link (root): cpe_477

Follow the submission guideline to be awarded points for this Assignment.

Submit the following for all Assignments:

1. In the document, for each task submit the modified or included code (from the base code) with highlights and justifications of the modifications. Also include the comments. If no base code is provided, submit the base code for the first task only.
2. Create a private Github repository with a random name (no CPE477/677, Lastname, Firstname). Place all assignments under the root folder, sub-folder named Assignmentn, with one document and one video link file for each lab, place modified c files named as main.c.
3. If multiple ‘c’ or ‘h’ files or other libraries are used, place these files inside the folder.
4. The folder should have a) Word document (see template), b) source code file(s) with other ‘c’ and ‘h’ include files, c) text file with YouTube video links (see template).
5. Submit the PDF file in Canvas before the due date. The root folder of the github assignment directory should have the documentation and the text file with youtube video links.
6. Organize your youtube videos as playlist under the name “EMBSEC&ML”. The playlist should have the video sequence arranged as submission or due dates.
7. Only submit pdf documents. Do not forget to upload this document in the github repository and in the canvas submission portal.

1. Goal: Explain what is explored in this assignment and what was accomplished.

The goal of this assignment is to compare mathematically calculated Euler angles with filtered data to machine-predicted values from raw data. Also, we explored how to calibrate the device using the built-in calibration test.

Experimental setup: The board was plugged in via a mini USB. I used MEMS-Studio and Algobuilder to program the board.

Calibration steps: I used the given calibration test located in C:\Users\"user"\STM32Cube\Repository\Packs\STMicroelectronics\X-CUBE-MEMS1\11.3.0\Projects\NUCLEO-F401RE\Applications\IKS4A1. With the accelerometer, I placed the board on each axis so the values should be 9.81 from gravity. With the gyro, I placed the board still in place and didn't move the area around. With the magnetometer, I used the figure 8 move, with alternating speeds.

regression approach: For this part of the project, I used raw IMU data as the input features, and the Euler angles from the calibrated complementary filter as the target outputs. The goal was for the regression models to learn how to estimate roll, pitch, and yaw directly from the uncalibrated sensor readings.

2. Screenshots of the IDE, physical setup, and debugging process – Provide screenshots of successful compilation, screenshots of graphs, etc.

```
PS C:\Users\Nicol\Downloads\da_2> python .\DA_2.py

LINEAR REGRESSION
Roll:
  RMSE: 34.3779
  MAE:  24.2003
  R²:   0.5409
Pitch:
  RMSE: 12.9395
  MAE:  8.5609
  R²:   0.7888
Yaw:
  RMSE: 69.8010
  MAE:  59.5353
  R²:   0.4159

POLYNOMIAL REGRESSION
Roll:
  RMSE: 23.6142
  MAE:  14.9631
  R²:   0.7834
Pitch:
  RMSE: 8.9802
  MAE:  6.5246
  R²:   0.8983
Yaw:
  RMSE: 55.5258
  MAE:  45.0820
  R²:   0.6304

DECISION TREE
Roll:
  RMSE: 11.3627
  MAE:  6.7643
  R²:   0.9499
Pitch:
  RMSE: 7.4908
  MAE:  4.8107
  R²:   0.9292
Yaw:
  RMSE: 32.9144
  MAE:  17.4445
  R²:   0.8701
PS C:\Users\Nicol\Downloads\da_2>
```

3. Declaration

I understand the Student Academic Misconduct Policy -
http://studentconduct.unlv.edu/misconduct/policy.html

"This assignment submission is my own, original work".
Name of the Student