Terrrain Classification

Create By: Kevin Ta
Contact: kevinta@alumni.ubc.ca
Date: 2019 August 30

https://github.com/kev-in-ta/CARISPAWProject

This project is comprised of a number of integrated systems that perform data acquisition, data processing, and terrain classification utilizing trained machine learning algorithms.

Wheel Modules

The wheel modules run off of a Teensy 3.6 development board and capture IMU signals from the wheels to transmit wirelessly through bluetooth.

NOT IMPLEMENTED

CarisPAWMsg

```
carisPAWMsg.time_stamp = timeSinceTeensyStart (ms)
carisPAWMsg.sensorType =IMU_6
carisPAWMsg.acc_x = x acceleration value in g
carisPAWMsg.acc_y = y acceleration value in g
carisPAWMsg.acc_z = z acceleration value in g
carisPAWMsg.angular_x = x ang. velocity value in deg/s
carisPAWMsg.angular_y = y ang. velocity value in deg/s
carisPAWMsg.angular_z = z ang. velocity value in deg/s
```

Left Wheel Module

Calibrate in static state to remove offsets

Variable in Memory

333.33 Hz

Read data from MPU-6050 (6-axis IMU)

TeensyClient.ino

Encode Message Using Proto Buffers

Encode proto buffers using COBS

Transmit packet to server via Bluetooth

11 22 02 33 — COBS Encoding → 04 ?? ?? ?? ?? — Packetize → 04 ?? ?? ?? ?? 00

Original Data | Overhead byte | Transformed Data | Delimiter Byte

Right Wheel Module

Calibrate in static state to remove offsets

Variable in Memory

333.33 Hz

Read data from MPU-6050 (6-axis IMU)

TeensyClient.ino

Encode Message Using Proto Buffers

Encode proto buffers using COBS

Transmit packet to server via Bluetooth

Frame Module

The wheel modules run off of a Raspberry Pi 3B+ to collect and process data.

9-Axis IMU

NOT IMPLEMENTED

Calibrate in static state to remove offsets

Pickle to import from other processes

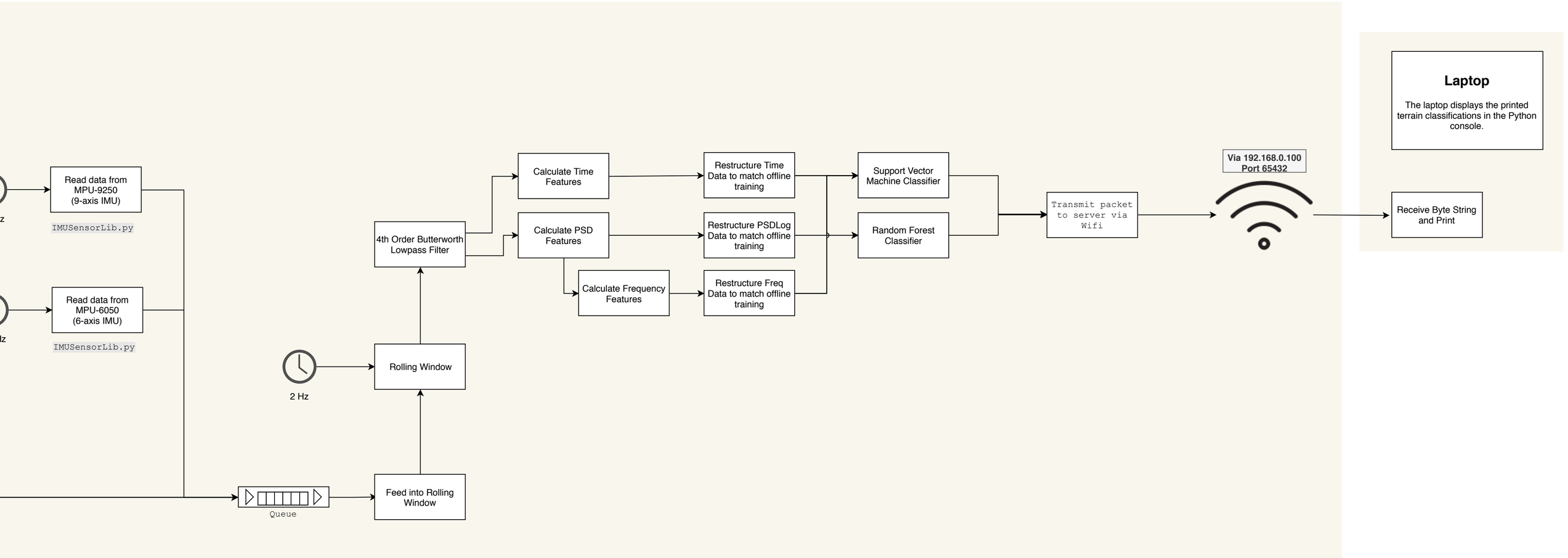
100 H

6-Axis IMU

Calibrate in static state to remove offsets

Pickle to import from other processes

300 H


Read data from MPU-9250 (9-axis IMU)
IMUSensorLib.py
Read data from MPU-6050 (6-axis IMU)
IMUSensorLib.py
2 Hz
Queue
Feed into Rolling Window
Rolling Window
4th Order Butterworth Lowpass Filter
Calculate Time Features
Calculate PSD Features
Calculate Frequency Features
Restructure Time Data to match offline training
Restructure PSDLog Data to match offline training
Restructure Freq Data to match offline training
Support Vector Machine Classifier
Random Forest Classifier
Transmit packet to server via Wifi
Via 192.168.0.100 Port 65432
Receive Byte String and Print
Laptop
The laptop displays the printed terrain classifications in the Python console.