Supervised Data Logger

Creating Real-time Training Data, by Chuck Bolin, November 12, 2017

Motivation and Overview

The supervised data logger project is one of three projects to develop an autonomous proof of concept system.

The goal of the first project is to collect 15 data features from sensors along with the operator's annotated data to produce a supervised training data file. Sample data is shown in Figure 1.

DateTime	Temp	Humidity	Pressure	Yaw	Pitch	Roll	MagX	MagY	MagZ	AccX	AccY	AccZ	GyroX	GyroY	GyroZ	State
01:14.4	28.722	35.308	1027.313	233.5918	27.6327	3.553143	-15.2022	32.32678	59.62383	0.085583	0.158058	0.90509	-0.0634	0.165575	0.631669	turn_right
01:14.6	28.758	35.029	1027.354	237.4626	25.77342	7.424821	-13.3654	30.81022	60.1079	0.125345	0.150046	0.805662	0.034952	0.164048	0.3467	turn_right
01:18.1	28.491	36.394	1028.993	239.2832	351.5628	336.1677	-22.3462	17.56198	63.4661	0.122193	0.279211	1.010611	-0.08903	-0.10319	-0.10319	turn_left
01:18.3	28.491	35.68	1029.079	230.7799	351.0423	335.1911	-32.0004	3.654328	66.69008	0.163893	0.024036	1.174863	-0.45127	0.308537	-0.47887	turn_left

Figure 1 - Data Sample

The goal of the second project is to select various features from the training data to build a data model that classifies the sensor data into one of 8 states. The 8 states are standing, walking, spinning left, spinning right, turning left, turning right, going up stairs, and going down stairs.

The goal of the third project is to deploy the data model into the data logger and modifying the program. The new program will utilize the data model to predict the current state using sensor data as the operator moves about indoors and outdoors.

Data Logger

The hand-held Data Logger (see Figure 2) automatically records date, time, 14 sensor measures and allows the operator to annotate the current state of the operator. The Data Logger consists of the following hardware and software components.

Hardware

- Raspberry Pi 3 (Raspbian OS)
- Sense HAT, installed on top of the Raspberry Pi
- 5V battery
- USB to mini-USB cable

Software

- Python 2.7

Figure 2 - Data Logger

Annotating Data

The most significant feature in this project is the annotation of the state as the operator moves about indoors or outdoors. The 8 states are indicated by the following icons.

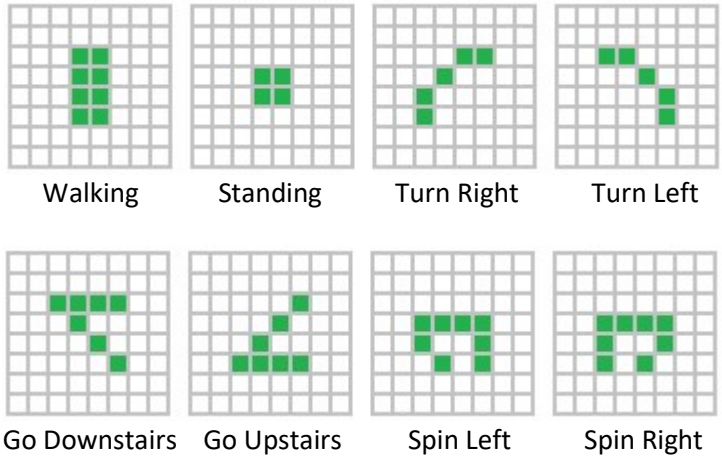

Figure 3 – Move State Icons

The operator moves the joystick up or down to change the state. Data logging is toggled on and off by pressing the joystick. Data is logged with the current configuration six times per second.

Program Development and Testing Workflow

The development software is installed on a Windows 10 operating system. The workflow is shown in Figure 4. Programming in Python is done using Notepad++ (see left side). Files are transferred from the Windows computer to the Raspberry Pi using Filezilla (see right side, top). Putty is the command line interface program that allows the developer to navigate the Pi folder structure and to execute the Python program (see right side, bottom).

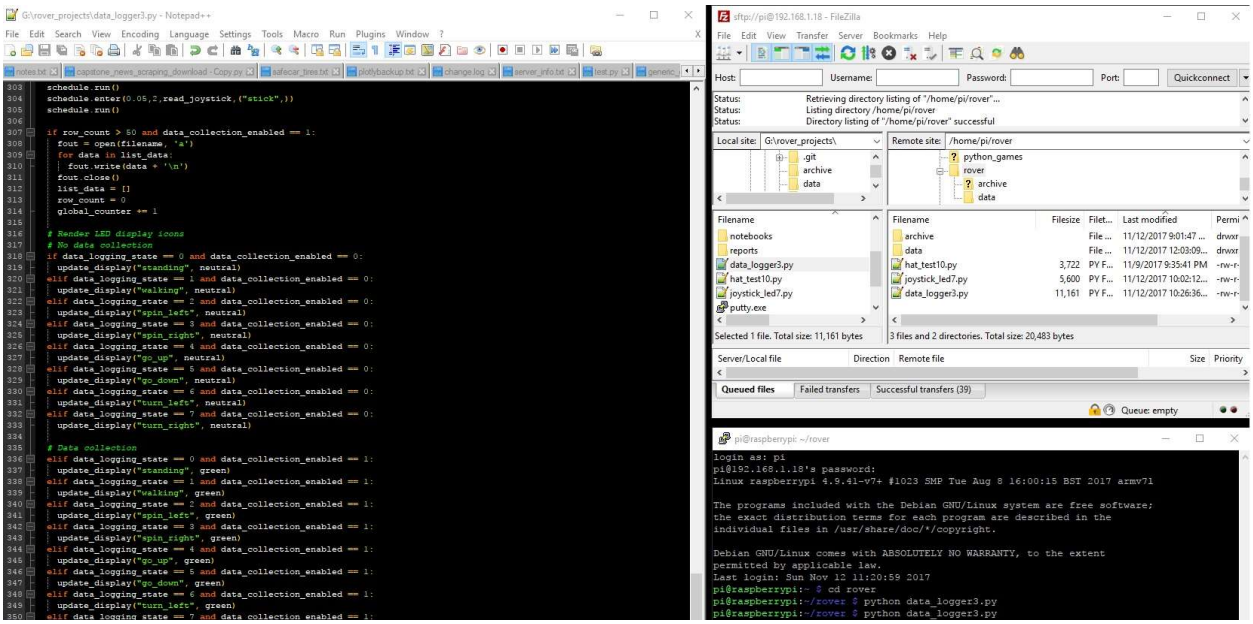

Figure 4 – Workflow

Setting Up the Raspberry Pi and Sensor HAT

This procedure uses these two products available from Amazon.com. NOTE: The procedure is a general guideline and may not include all details required to setup the system up. Use Google to locate additional tutorials and videos as required.

- https://www.amazon.com/CanaKit-Raspberry-Complete-Starter-Kit/dp/B01C6Q2GSY
- https://www.amazon.com/gp/product/B01MSL0Y5W/ref=oh_aui_detailpage_o00_s00?ie=UTF8&psc=1

1. Mount the Sensor HAT on top of the Raspberry PI.
2. Install the Raspberry Pi with Sensor HAT into the enclosure provided with the Sensor HAT.
3. The transparent cover on the Sensor HAT enclosure is not required.
4. Insert the 32 GB Micro SD card preloaded with software.
5. Connect the USB mouse, USB keyboard, and HDMI monitor cable to the Raspberry PI.
6. Connect the power supply to the Mini-USB port.
7. An icon will be displayed on the monitor. Click the icon.
8. Install the Raspbian operating software from the list of available programs.
9. Reboot the PI. A windows-like interface will be displayed.
10. Connect the Pi to your home network.
11. Use IP Scanning software or your Router configuration to determine the network IP address.
12. The PI will remember the IP address each time it boots up. NOTE: IP address may change if a dynamic address is used.

13. Use Putty.exe to connect to the Raspberry Pi. Connect to the IP address and default port 22. The PI comes with a default user and password.
14. Use Filezilla.exe to connect to the Raspberry Pi. The host name is in the format 'sftp://pi@192.168.1.18'.
15. Reference the Sensor HAT API and write a simple program with a text editor (e.g. Notepad++). Load the program into the Raspberry PI via Filezilla. Use Putty to execute the python script. This is done by using the format 'python program_name'.

Check the GitHub archive folder for various developmental version of programs.
https://github.com/ChuckBolin/Rover/tree/master/archive

Python Code

All code has been placed into a single file and has not been optimized. The file is located here.
https://github.com/ChuckBolin/Rover/blob/master/data_logger3.py

All my software and variants, data, and tableau workbooks. https://github.com/ChuckBolin/Rover

More Useful Links

- CanaKit – Raspberry Pi, SD card, and power supply. https://www.amazon.com/CanaKit-Raspberry-Complete-Starter-Kit/dp/B01C6Q2GSY
- SensorHAT with enclosure. https://www.amazon.com/gp/product/B01MSL0Y5W/ref=oh_aui_detailpage_o00_s00?ie=UTF8&psc=1
- Putty download. https://www.chiark.greenend.org.uk/~sgtatham/putty/latest.html
- Filezilla FTP. https://filezilla-project.org/
- SenseHAT API. https://pythonhosted.org/sense-hat/api/
- Tutorials, Hints, Videos, etc. https://www.google.com