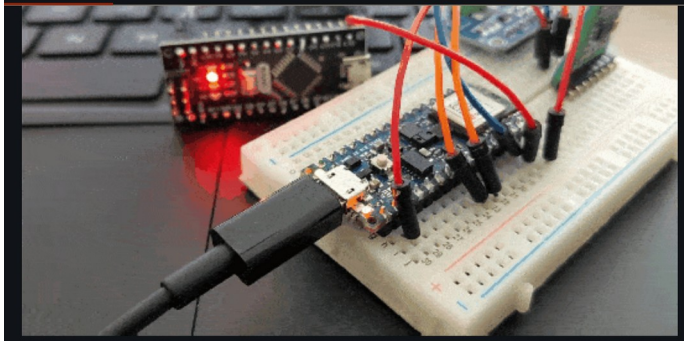
2021

https://github.com/Santandersecurityresearch/CurrentSense-TinyML

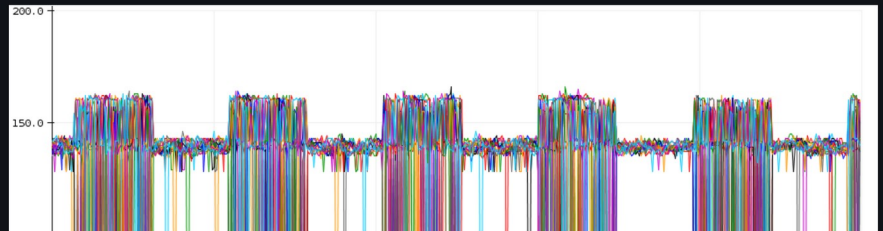
- Santander Group Cyber Security Research Team
- read current from target and predict LED on / off state

README MIT license



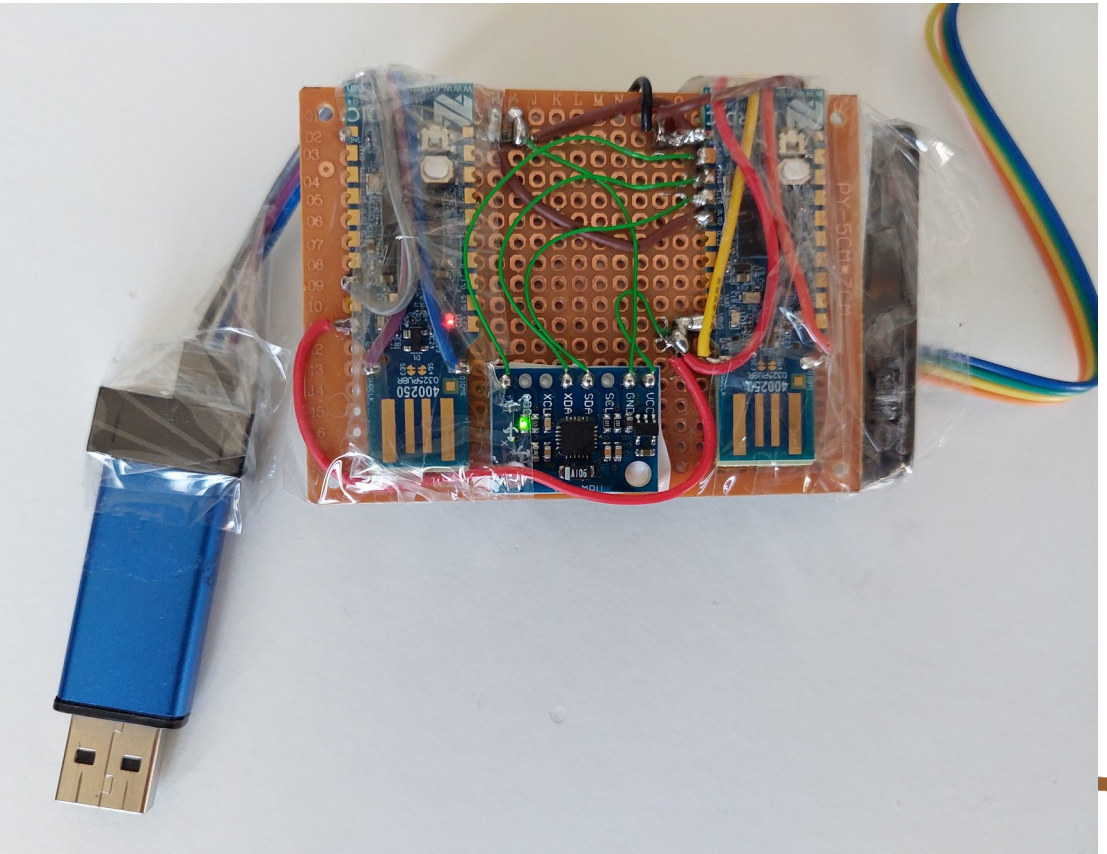
What is CurrentSense-TinyML (and does it work?)

Despite prior evidence that says 'yes!' from the work we cited above, there are a few good indicators that this should work. If we setup the INA219 with the Nano 33 Sense and just monitor the Nano target running blink, we can see the following output when we use Arduino IDE's Serial Plotter (using the get_current_data.ino code for those who want to play along at home)



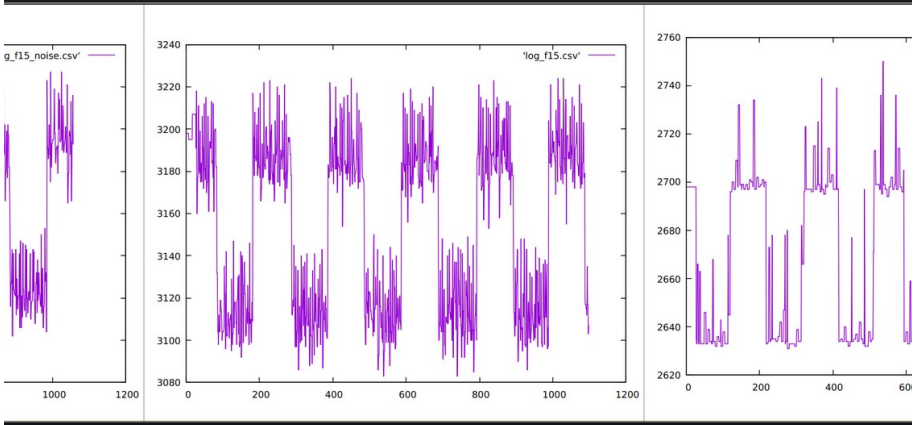
2021

- didn’t finish the project due to my lack of knowledge
- no AI to help as of today in 2024



/ machine_learning_board_firmware

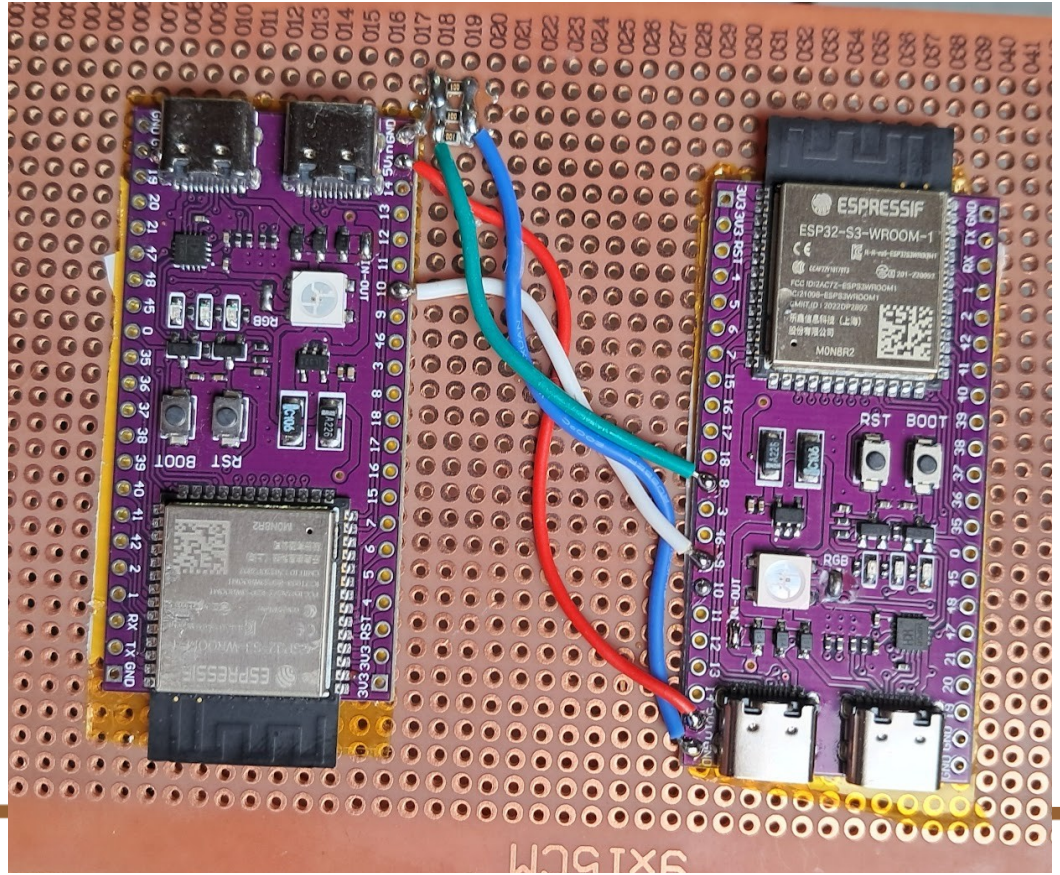
/ 02.png



2024

left: target board | right: observer board

RGB LED: R, G and B values [0 - 255]



- Python firmware on both boards + PC software
- ADC oversampling to reduce the noise
- PC software is ready to receive current and send the RGB value

main.py - 02_observer_firmware - Visual Studio Code

File Edit Selection View Go Run Terminal Help

EXPLORER

02_OBSERVER_FIRMWARE

- .vscode
- lib
- sd
- boot_out.txt
- boot.py
- main.py
- settings.toml

main.py > ...

```python
while True:

    # when we receive the UART data, the target RGB LED values just changed
    target_data_uart = uart.read()
    if target_data_uart is not None:
        # sometimes the rx UART values are not ok (like at startup)
        # this try except will skip that case
        try:
            rgb = str(target_data_uart, 'utf-8').split(',')
            r = int(rgb[0])
            g = int(rgb[1])
            b = int(rgb[2])
            rx_new_rgb_values = True
        except:
            pass

        # in the case of new RGB values, update the RGB LED and send the values to the PC
        if rx_new_rgb_values:
            rx_new_rgb_values = False

            if running_mode == 'usb_pc_enabled':
                # wait sometime for the RGB LED current to stabilize
                time.sleep(0.01)

                # send the values to PC
                target_current = read_target_current()
                string_to_send = f'{round(target_current, 6)},{r},{g},{b}\n'
                uart_usb.write(bytes(string_to_send, "utf-8"))
                uart_usb.flush()

        # reset the buffer as we should not receive any new data up to now
```

OUTLINE

TIMELINE

0 0 0 Spaces: 4 UTF-8 LF Python 3.10.12 64-bit <Choose a board>

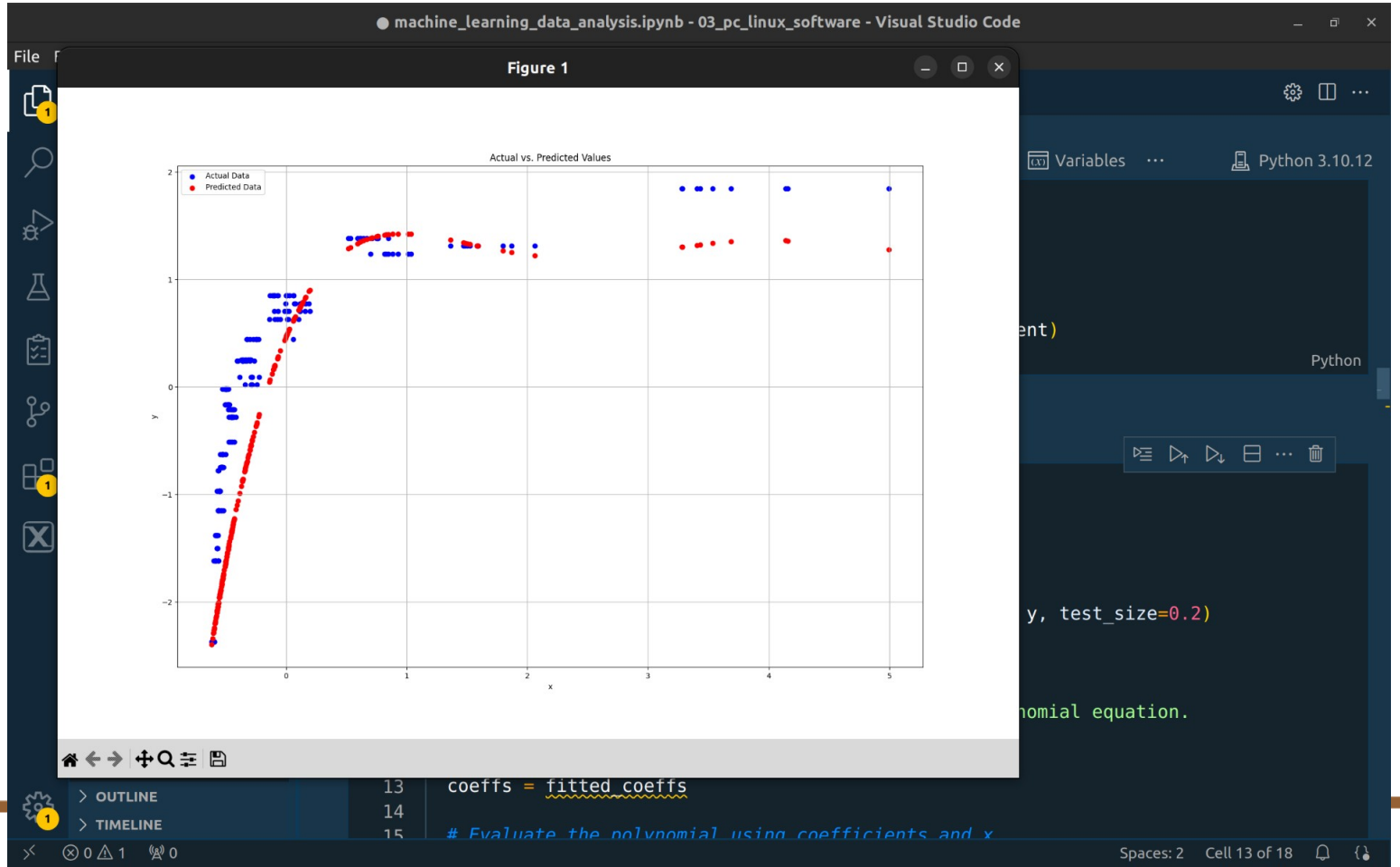
27 possible combinations

```python
# Read the data file
df = pd.read_csv("./labeled_dataset_1_small.csv", sep=',')

# Print the data for verification
print('\n\ndf.head(10):\n')
print(df.head(10))
```

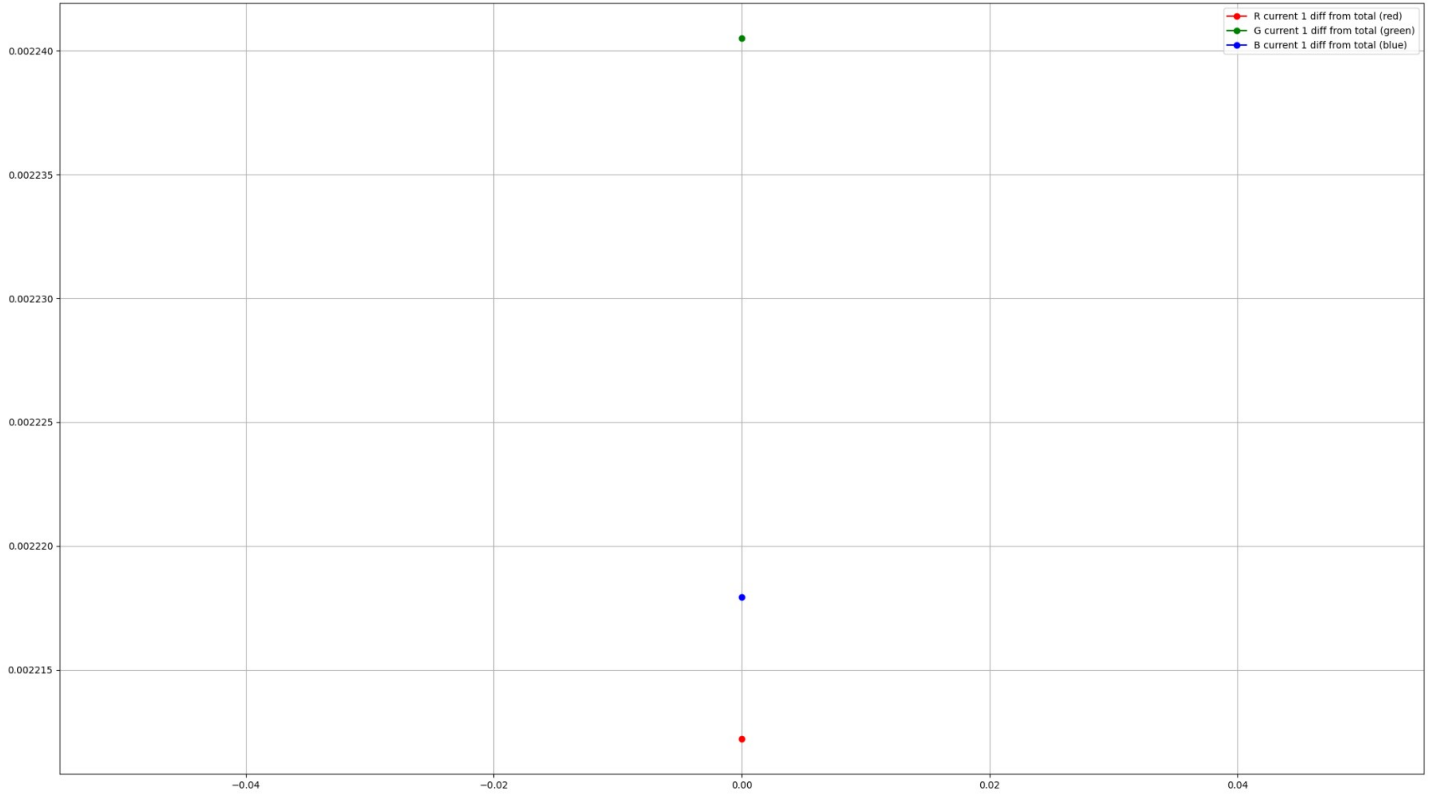
69] ✓ 0.0s

```
df.head(10):

    current      R      G      B
0  0.036605  0.639  0.639  0.639
1  0.001844  0.396  0.000  0.396
2  0.012273  0.639  0.396  0.639
3  0.002571  0.639  0.000  0.396
4  0.012477  0.639  0.396  0.639
5  0.006664  0.396  0.396  0.639
6  0.012040  0.396  0.639  0.639
7  0.038608  0.639  0.639  0.639
8  0.001615  0.000  0.396  0.000
9  0.002370  0.639  0.000  0.396
```

- feature engineering
- testing polynomial fit



- very small differences of each current from the total currents
- need to (quickly) improve the hardware to read higher values



c / ML_predict_target_board_RGB_LED_state-ESP32-S3_Ci...

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ML_predict_target_board_RGB_LED_state-ESP32-S3_CircuitPython

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casainho update for class presentation d72123e · now 5 Commits

01_target_firmware	Added PC python script to log labeled data	last week
02_observer_firmware	update for class presentation	now
03_pc_linux_software	update for class presentation	now
LICENSE	Initial commit	3 years ago

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