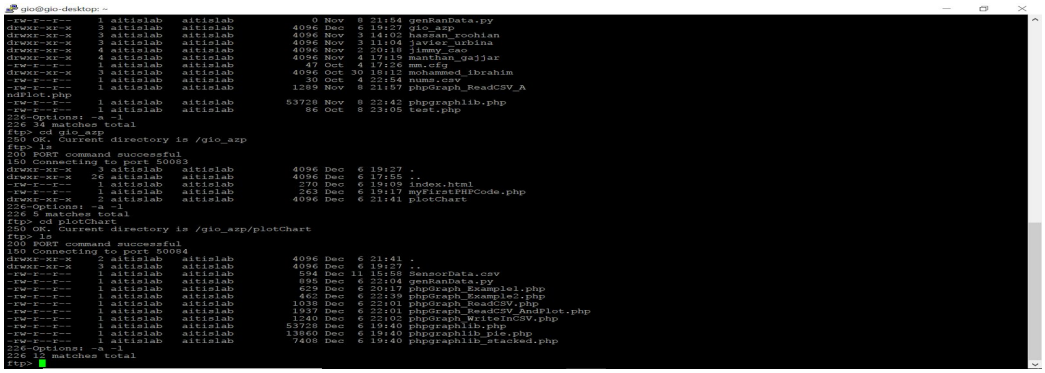
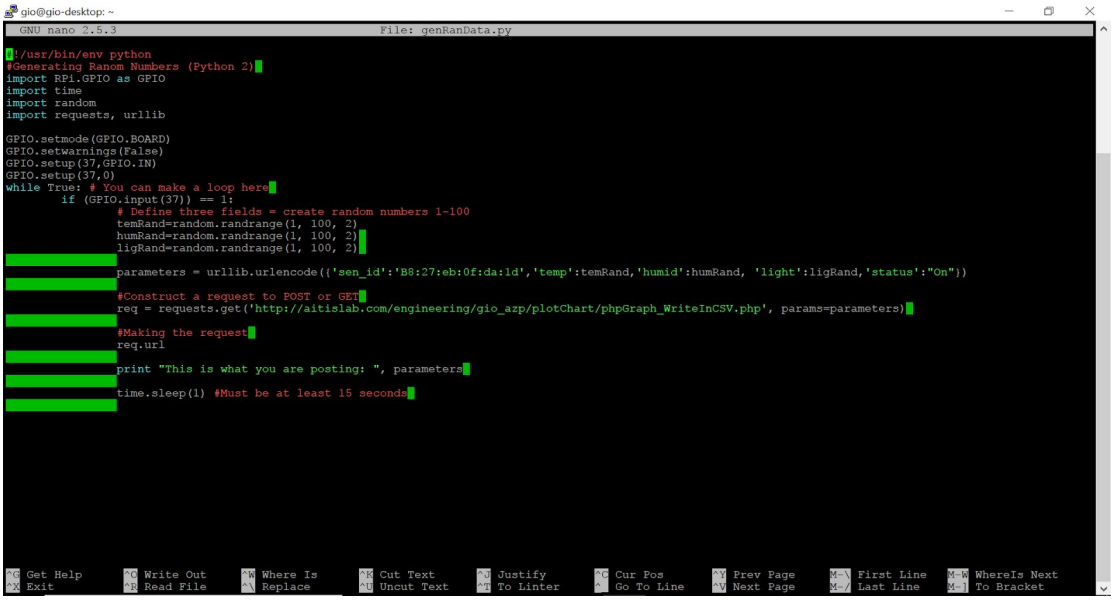
2.4 Testing

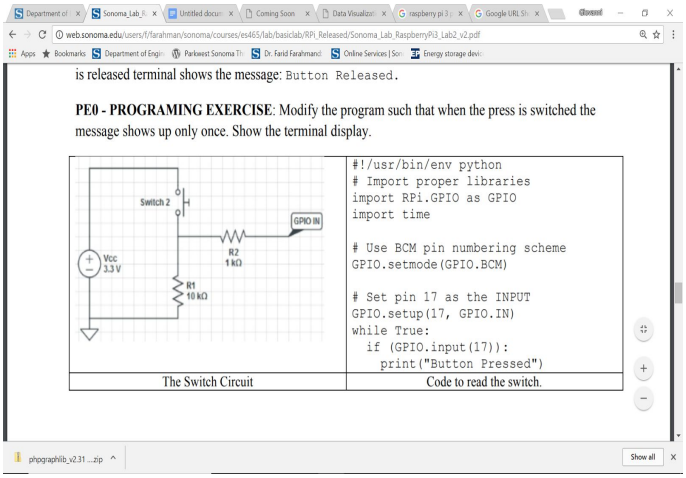
Test 1: Sending data to a web server and displaying it on a webpage.
Goal: To show data can be sent from the raspberry pi to a webserver and visualize that data on a plot in a webpage.
Parts used: Raspberry pi 3 Model B, Switch, 10k Resistor, 1 k Resistor, Breadboard, Wires.
Procedure and Results
In this test we are using the raspberry pi as the client to send data to an existing web server; aitislab.com. Once we access into the server via FTP, we create some directories and files to add codes and libraries to visualize plots and send data.



We use CSV files to store the data and PHP-base scripts to visualize the data.
For this test we use PHP Graph to see our gathered data.
The following image shows the code used to generate random data and send it to the server.



The image below show the circuit diagram and how we implemented it on the breadboard.



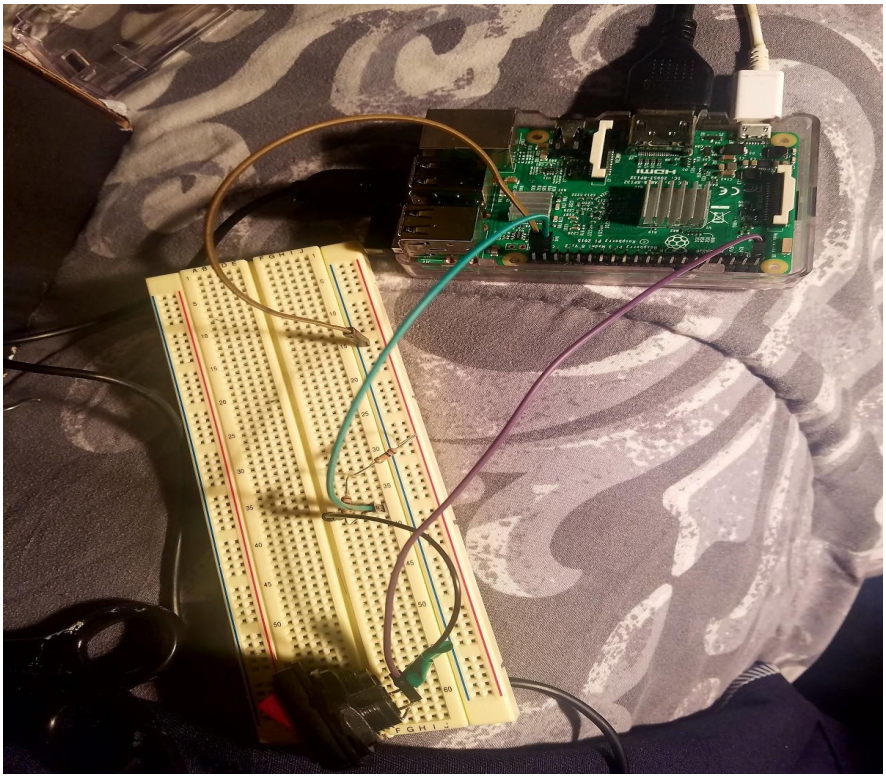
is released terminal shows the message: `Button Released`.

PE0 - PROGRAMING EXERCISE: Modify the program such that when the press is switched the message shows up only once. Show the terminal display.

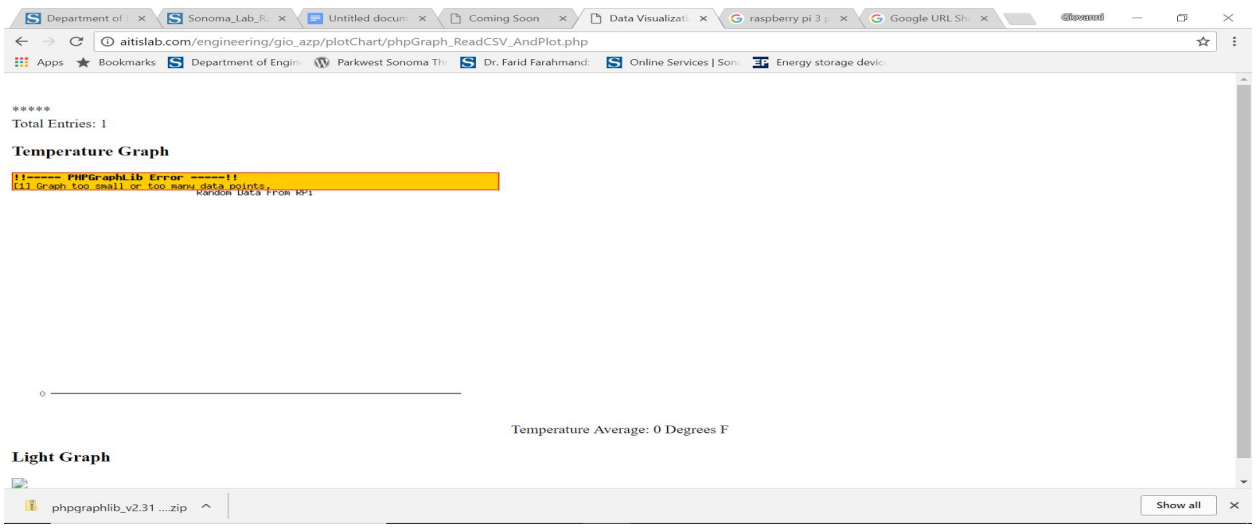
The Switch Circuit

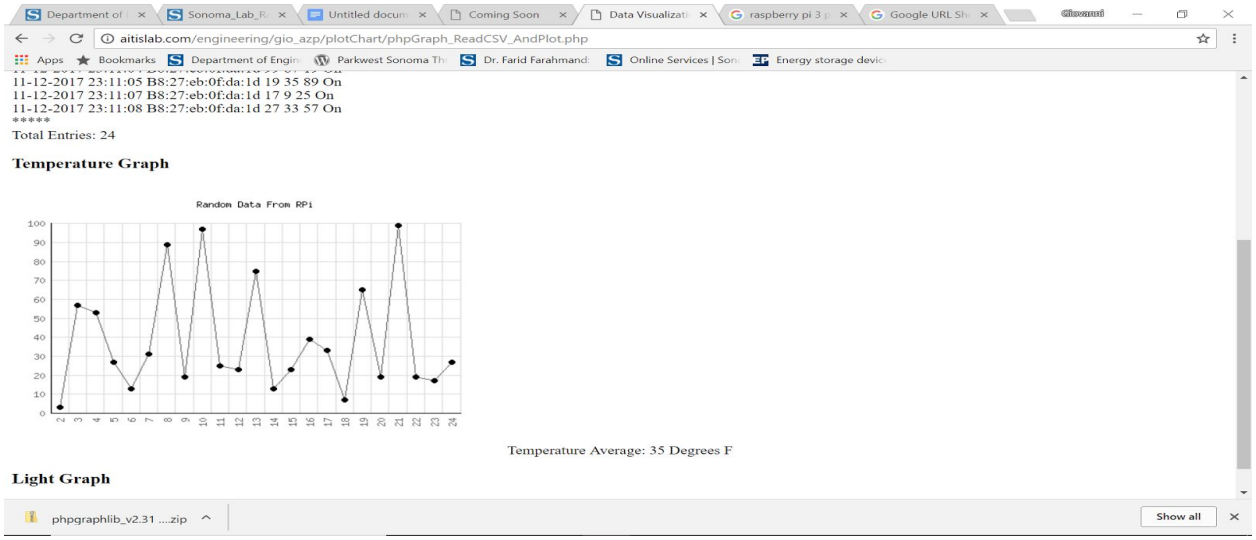
```
#!/usr/bin/env python
# Import proper libraries
import RPi.GPIO as GPIO
import time

# Use BCM pin numbering scheme
GPIO.setmode(GPIO.BCM)

# Set pin 17 as the INPUT
GPIO.setup(17, GPIO.IN)
while True:
  if (GPIO.input(17)):
    print("Button Pressed")
```

Code to read the switch.



Next, we show the CSV file before and after we collect the data. The first image shows the empty file and therefore no graph is shown. The second image shows the plotted data once we run the program and collected some points after pressing the switch





Lastly, here is the link for the web page displaying the data

https://goo.gl/P8ekM1

Conclusion: With this test we have shown it is possible to collect, send data and display it on a webpage. However, we would like to use the Pi as its own web server but the challenge will be accessing to the info from places other than the LAN.

Reference: *"Using PHP to Plot Data Lab"* , SSU, Electrical Engineering

Test 2: Powering up the Raspberry Pi directly from the Solar Panel.

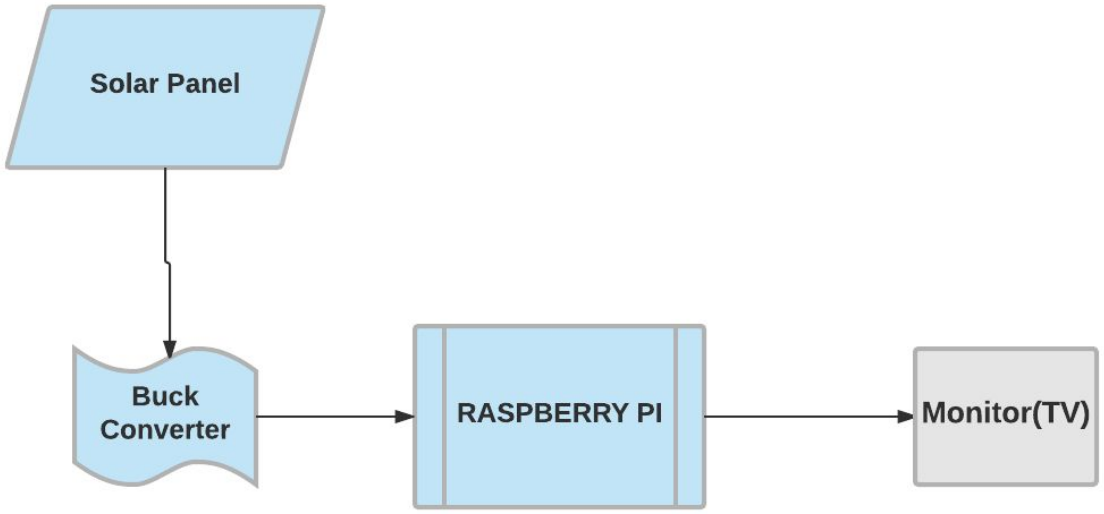
Goal: The goal of this test is to power up the raspberry Pi directly from a solar panel, no battery attached to it.

Parts Needed: Raspberry Pi Zero W, Solar Panel, XH-M401 Buck Regulator, Multimeter, 500 W Halogen Light.

Procedure and Results.

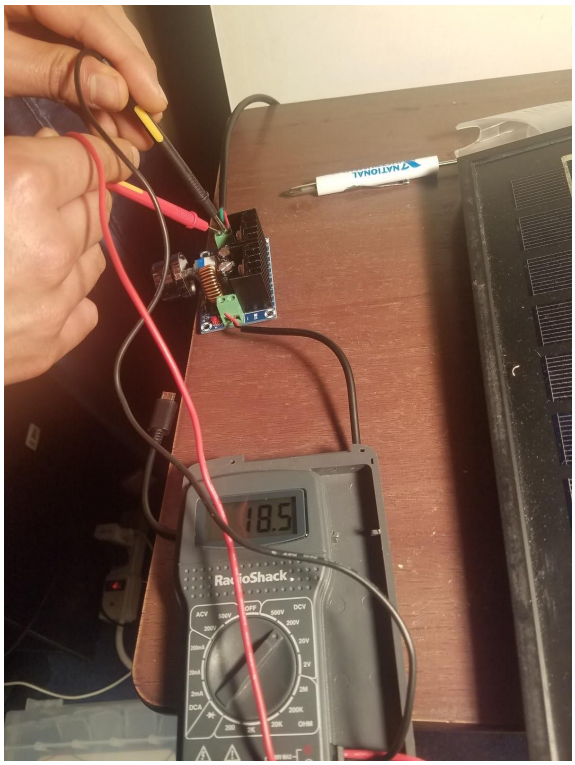
The test was taken in a bedroom, with a 500 W halogen lamp.

Test Setup

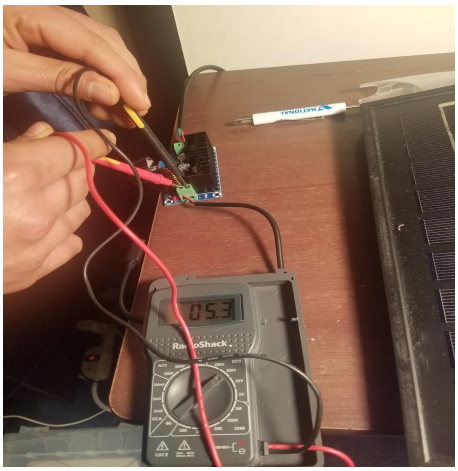


The picture below shows the setup for the test, it shows the solar panel connected to the buck regulator.

The measured voltages are shown in the following pictures.



The above picture shows the DC Voltage coming out of the solar panel, the multimeter read 18.5 V.

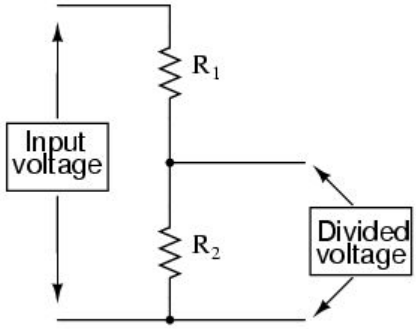


After the Buck Regulator the voltage drops to 5.3 V, a voltage we can use to power up our Pi. Note: We tried to power up the Raspberry Pi 3 Model B. To do so, we needed a booster because it requires more current(730 mA, 3.7W. The booster we used burned out, therefore we decided to

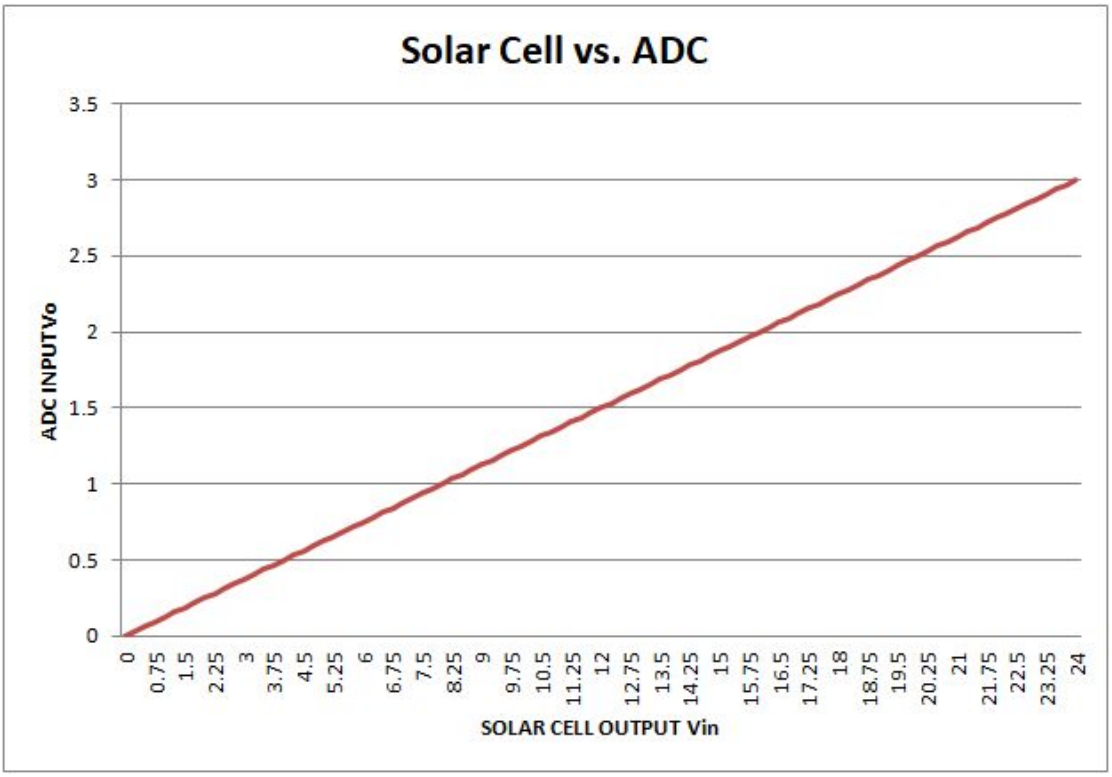
power up the raspberry Pi Zero W. It uses much less Power and we could power it directly from the Solar Panel.

The following link shows a video of our successful test.
https://drive.google.com/open?id=1sK68CSbu5ljRQXEbEqI_UcJ1_JJw7Ss-Tw
Conclusion: After this test, we realized it was better for our project to go with the raspberry Pi Zero W. It uses less power and it has what we need; Wifi and GPIO (for the ADC).

Test 3: Simple voltage scaler using voltage division
Goal: To show solar voltage ranging from 0-24 volts can be scaled down to 0-3 linearly for the analog to digital converter.
Parts used: 5 watt solar cell and two resistors (1k ohm, 7k ohm.)
Procedure and Results

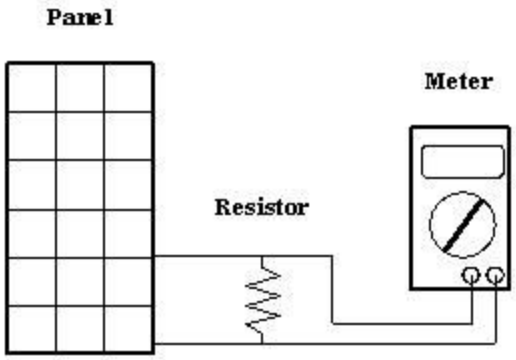


Voltage divison is an easy concept. Vout = Vin(R2/R1+R2). At 0 volts in, we get 0 volts out. At 24 volts in, we get 3 volt out.
3 = 24(1/8) volts



Test 4: To characterize the I-V curve of our 25 Watt solar panel

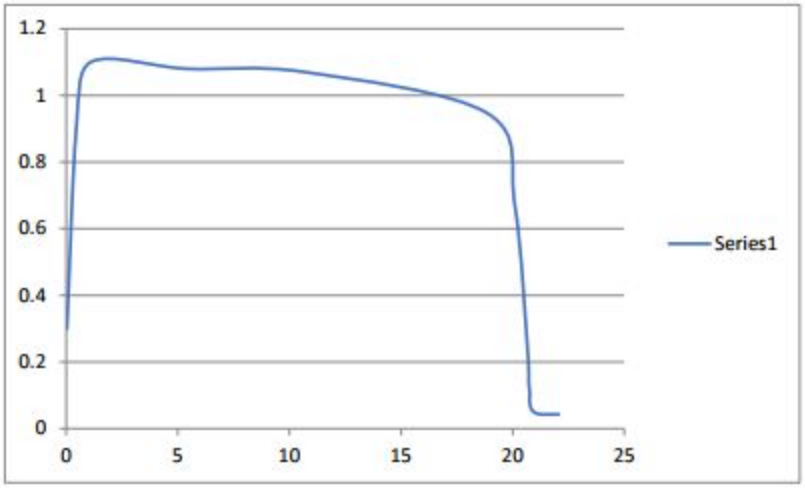
Goal: To determine load required for max power
Parts used: 25 watt solar cell, 100 watt potentiometer, Fluke 115 multimeter
Procedure and Results



Testing environment was outside in direct sunlight (note: leaves shown in photo were not a factor)

Results:

V	R	I	P
0.03	0.1	0.3	0.009
0.45	0.5	0.9	0.405
1.1	1	1.1	1.21
5.4	5	1.08	5.832
10.7	10	1.07	11.449
18.9	20	0.945	17.8605
20.1	30	0.67	13.467
20.7	99.8	0.20741483	4.293486974
20.72	147.7	0.14028436	2.906691943
20.77	198.3	0.104740292	2.175455875
20.75	248.8	0.083400322	1.730556672
20.79	301.2	0.069023904	1.435006972
20.83	353.4	0.058941709	1.227755801
20.91	401	0.052144638	1.090344389
21.03	448.3	0.046910551	0.986528887
21.25	499	0.04258517	0.90493487
22.07	517.1	0.042680333	0.941954941



Conclusion. The load required for maximum power is around 20 ohms.