**Overview:**

For our exploration project we decided to give a comprehensive overview on a capacitive soil moisture sensor. This sensor works by measuring the capacitance of the soil to detect changes in the moisture. To use the soil moisture sensor, plug-in an analog to digital convertor (ADC) chip that relays the information back to the Pi through the SPI pins to make sense of the data. The raw data from the soil moisture sensor varies on a scale of approximately 540-900. This was found by comparing sample results when the sensor was sitting out on the desk and when it was completely submerged in water. These two extremes helped us determine the scale. It was 540 when it was completely submerged in water and 900 when it was dry on the desk. However, we did notice a variance when it was at either extrema and the data was not consistent. There was a variance of approximately 10-50 where the sensor could read anywhere from 900-950 when it was dry and 520-540 when it was wet. To make sure the output read correctly at the extrema we scaled these values where anything above 900 represented 0% moisture, and anything below 540 represented 100% moisture. To make it easier to read we coded a program to convert the raw data into a percentage value to make it easily understandable.

**Packages:**

The package that are required for the soil moisture sensor is the SPI library. This is used to connect to the ADC and to receive data from the soil sensor. To automate the process of the sensor checking the moisture level, we used the time and math library within Python. The time library was used to stop the execution of the program to allow the user to read the values and the math library was used to convert the raw data value to a legible percentage value. Lastly, all this was downloaded to Pi via Raspbian.

**Challenges/Issues:**

* Locating loose wires which were caused during set-up and take down of the work sessions.
* Finding malfunctioning wires related to the TTL serial cable, which cause the connection from the Pi to drop and caused the running Python programs to become corrupt
* Investigating a blown out ADC chip, this was an issue because it would not allow the circuit to function as intended and there is no apparent way to detect the issue other than trial and error.
* Determining the range of values of the raw data from the soil moisture sensor because it would sometimes exceed 950 as a maximum value for the dry case, and other times it would cap at 900.

**Useful Links:**

<https://www.dfrobot.com/wiki/index.php/Capacitive_Soil_Moisture_Sensor_SKU:SEN0193>

This link was used to find out what depth works best for the sensor. Also, it described what depth not to exceed.

<http://denethor.wlu.ca/pc320/python/spi_in_test_2018.py>

This link was useful in determining how to the data from the soil sensor to the ADC and to the Pi.

<http://denethor.wlu.ca/pc320/datasheets/MCP3008.pdf>

This link was great for finding out how to use the ADC chip and how it operates with an SPI device and connects to the Pi.