Topic: Stable moisture level measuring and analog output reading

Objective:

Our project is a smart gardening system for pot moisture level monitoring. Therefore, we need to be able to know how dry or wet the soil is and gives feedback to the BeagleBone to process the data.

Problem #1:

To measure the moisture level of the soil, we are using the capacitive soil moisture sensor, see figure 1. The area circled in red needs to be insert into the soil and the sensor would output the analog voltage which can be read from the BeagleBone.

To active the sense, a supply power of 3.3 - 5.5V is used. However, when we are using 3.3 - 5.5V for the sensor, the analog readings seem to get stuck at the value of 4095, which is the maximum value of any analog pin.

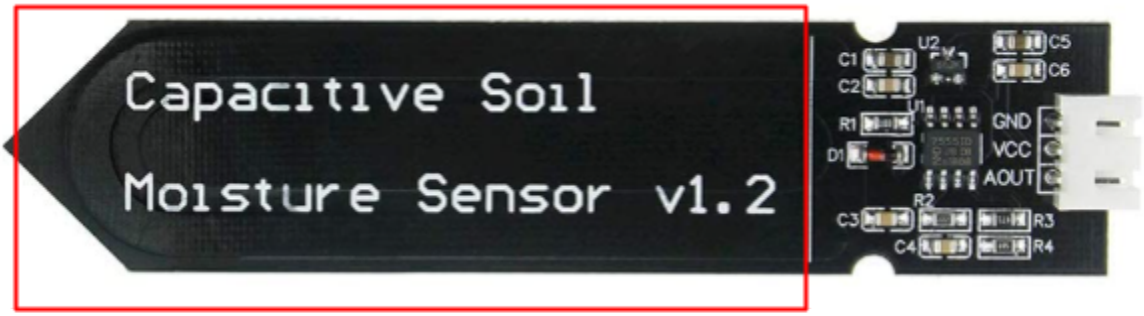

Figure 1: Capacitive soil moisture sensor

```
Value1   4095 ==>   1.80V
Value5   4095 ==>   1.80V
Value0   4095 ==>   1.80V
Value1   4095 ==>   1.80V
Value5   4095 ==>   1.80V
Value0   4095 ==>   1.80V
Value1   4095 ==>   1.80V
Value5   4095 ==>   1.80V
```

Figure 2: readings are all 4095

Our solution:

After measuring directly from the “AOUT” pin, we can confirm that the sensor is working. The reason why the BeagleBone always reads the value 4095 is because the BeagleBone analog input pin only accept up to 1.8V , but we have a 3.3V sensor. When the sensor is dry, the capacitance is the smallest, therefore the analog output voltage from the sensor would be very close to 3.3V and that’s why the BeagleBone is always reading the maximum value. Our solution is to use a voltage divider to divide the voltage by half so the BeagleBone can read it properly.

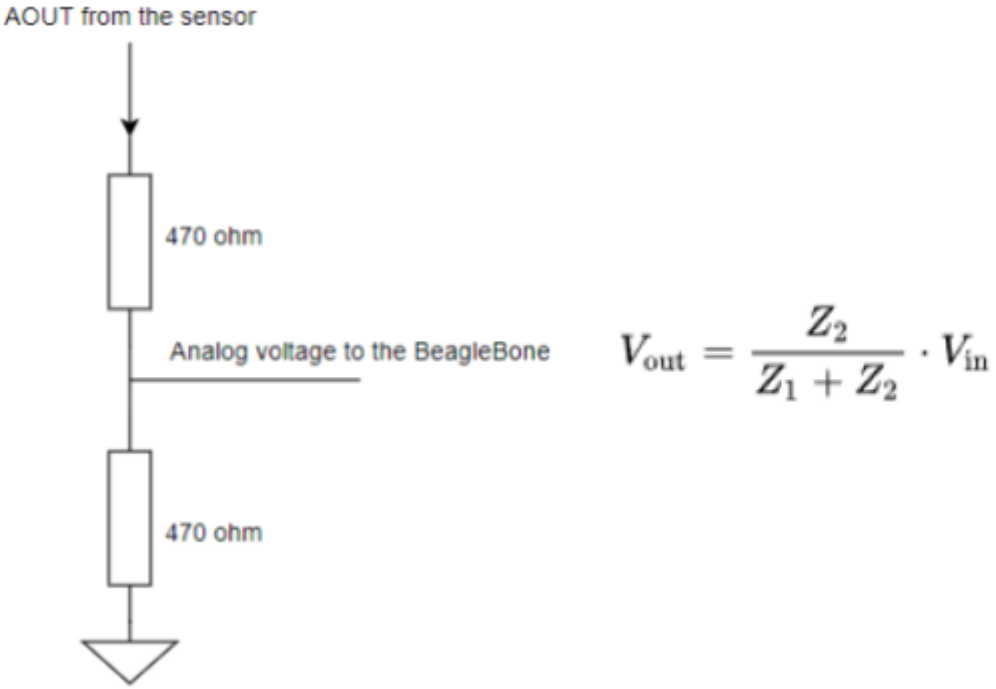

Figure 3: Voltage divider for analog reading

Problem #2:

After we resolve the problem 1, we were facing another problem which is dealling with some spiked readings. A few of the readings would go over or under the threshold and making the program confused about calculating the moisture level.

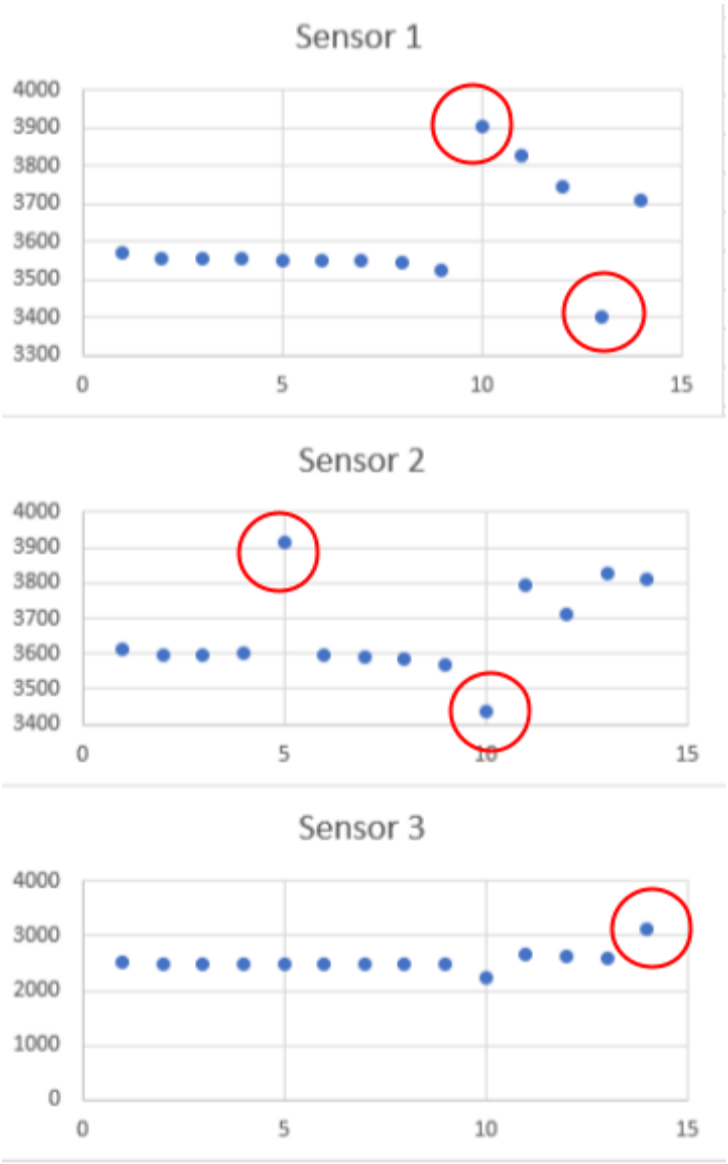

Figure 4: potential bad readings

Our solution:

To get more realistic and stable readings, we decided to the the average of 6 samples (sampling rate at 15 ms) and use it as the raw reading value for the main program. In this case, we can smooth the spike and still catch the reasonable differences between the readings.

Steps to troubleshoot:

1. If you are seeing the value 4095 and this value seems to be unchanged even you insert the sensor to very wet soil.
    a. Check if you are reading the correct analog pin
    b. Check if you are connecting to the correct analog pin
    c. Check if there's any loose connections
    d. Check if sensor is getting power in 3.3 - 5.5V range
2. If you think your sensor is not working/burnt.
    a. Use multimeter to check the voltage across the "VCC" pin and the "GND", it should be higher than 3.3V.
    b. Check if the "GND" pin is grounded with the common ground.
    c. Manually check the voltage across the "AOUT" pin and the ground pin in dry air, and carefully measure it again with the sense wrapped in wet wipe. When the sensor is waped in wet wipe, the voltage should read less than 3.3V.
3. If you see your sensor is doing the right thing but the program is not reading the right moisture level.
    a. You might have to re-calibrate your maximum and minimum raw data because the environment might affect the readings.
    b. You might have to adjust the sampling rate and the amount of readings to do averaging. The capacitance readings also depends on the firmness of the soil and the type of soil as well, therefore, it might bring a bit of trouble if you don't calibrate the senors before running the program.