Signoff Request - 5/4 -Humidity Sensor

Wednesday, May 4, 2022 12:26 PM

For the humidity sensor, combined temperature and humidity sensors were avoided to maintain modularity. This will also help keep the data separate which will make it easier to send over bus communication with an associated tag. Another way modularity will be maintained is through the use of small individual MCUs for each sensor. The MCU chosen was the Arduino mini based on the following criteria [1]. (This was chosen over the trinket due because the I2C and SPI pins don't overlap, it is only 0.1" longer and 0.1" wider)

- SPI and I2C capabilities
- 5V power supply
- Small form factor

Crawlspaces should have a normal humidity of 45% - 55% [2]. However, it is preferable for a larger range of humidity to be measurable as this gives the inspectors more data. It will also be preferable for the chosen sensor to not need calibration as this adds time to the robot startup and adds more areas for user error. Finally, as with the other subsystems, this sensor should be powered by either 5V or 12V.

For these reasons, the CC2D25S-SIP sensor was chosen. It is manufactured by Amphenol and can be found on Mouser. This sensor is able to run off the 5V bus and returns data over I2C which removes the need for filtering an analog voltage [3]. However, filtering is occurring on the PCB board and an accuracy of 2% is provided with a measurement range of 0% to 100%. It does not require calibration and is specified as being reliable in harsh environments. The final key feature of this board that makes it a good choice is that it runs in sleep mode [3]. This means it waits to collect data until it is told to start collecting by the MCU. Running the sensor in this way helps avoid overflowing the Raspberry Pi or Arduino with data and ensures the data was collected at the point it should be collected at. Figure 1 shows the schematic of how this will be plugged up to the Arduino mini.

This part of the subsystem will be triggered through a GPIO pin which will be set high or low by the main MCU. This trigger signal will start its measurement protocol in which multiple recordings will be taken and averaged together. For this operation, full bus control is not needed because only a go signal will be necessary to start the measurements. This also allows one-direction control to be done by the SPI which keeps those pins open for the I2C bus needed by the humidity sensor.

Figure 1 shows how the circuit will be set up. Only the data out pin is being used for the SPI communication since duplex communication between the Arduino Trinket and Raspberry Pi will not be necessary. The new microcontroller was chosen over the trinket because it features separate pins for the BUS protocols. This was necessary because putting everything on one system means each sensors MCU and sensor output are going to everyone and the data will not only get hard to track, it will become significantly less modular.

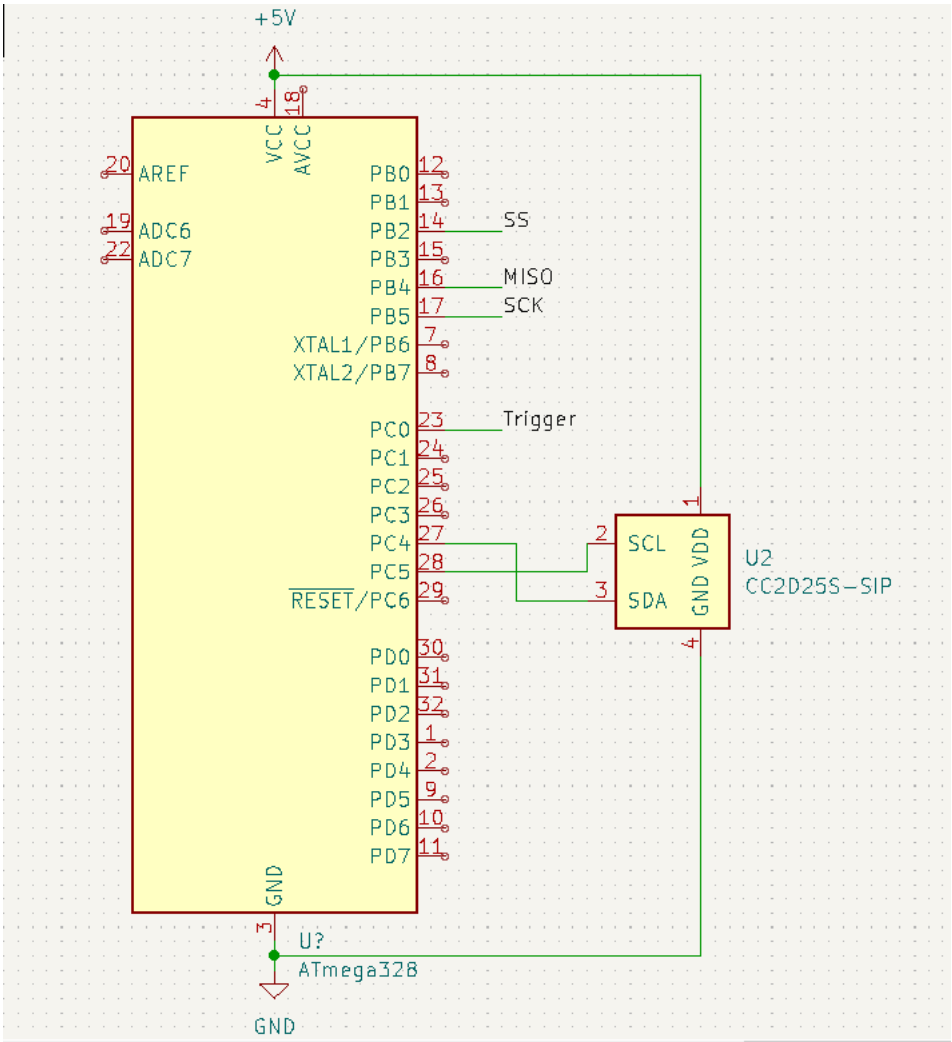

Figure 1: Humidity Sensor and MCU Schematic

[1] "Arduino Pro Mini 328 - 5V/16MHz." Arduino. https://www.sparkfun.com/products/11113 (Accessed May 5, 2022).
[2] Michael Church. "Best Humidity Level for Crawl Space." CrawlSpace Ninja. https://crawlspaceninja.com/blog/best-humidity-level-for-crawl-space/ (Accessed April 29, 2022).
[3] "ChipCap 2 humidity and temperature sensor." TELAiRE. https://www.mouser.com/datasheet/2/18/1/AAS_920_628B_Telaire_ChipCap2SIP_020316_web_pdf_3f-1315779.pdf. (Accessed April 29, 2022).