

CO2 and PWN fan report
ME121
26 May
German Markaryan

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Abstract

The goal of this assignment is to build and test a physical model of a room with an exhaust fan. The physical model is used in subsequent experiments. The experiments require the Feather nRF52480 Sense, the SGP30 air quality sensor, the OLED display, a 5V PWM controlled DC fan and the physical model of a room that I make. I also need to do a couple of experiments. Using a low-cost microcontroller, SGP30 sensor, 5VDC fan, and OLED display. I will make a device which should perform three main functions. First, my device should continuously display temperature, eCO₂ concentration measured by SGP30 and humidity values measured by the SHT30 sensor on-board the Feather nRF52840 Sense. Second, my device should control PWN fan by dimming and have 3 work status high, medium and low. Third, use of a deadband for the PWN fan control. To calibrate my deadband I used information from homework 3. I opened the box and recorder data from sgp30 sensor during a couple of minutes. Using excel I calculated the deadband value. All information is displayed on an OLED display. And I also calibrated my SGP30 sensor using scd30. The calibration formula – $f(x) = 3.2 * x + 500$.

Introduction

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Controlling CO2 level and humidity is very important. If we talk about CO2 concentration, as higher it is as bad people feel themselves, because organism need enough concentration of oxygen. Too high CO2 level can build up and create health, productivity and comfort problems for people. That's why in almost all new buildings a good ventilation system is a necessary feature. Indoor relative humidity is important too, because if it's continuously high it could give issues to your usual life. People feel different based on relative humidity. Moreover, it could damage human health. For example, Mold is a term for fungi that includes many different species, including Penicillium. There are thousands of known species of molds. Indoor mold can grow on surfaces if exposed to high air humidity levels for extended periods of time. Exposures may present health concerns: allergies and respiratory problems.

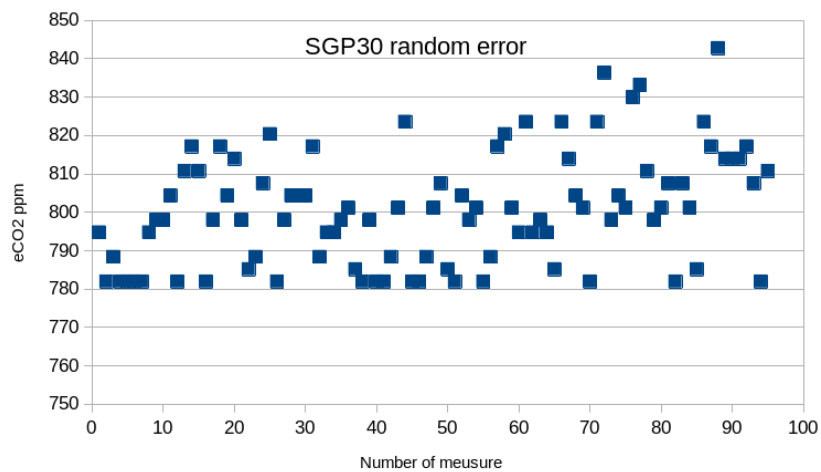
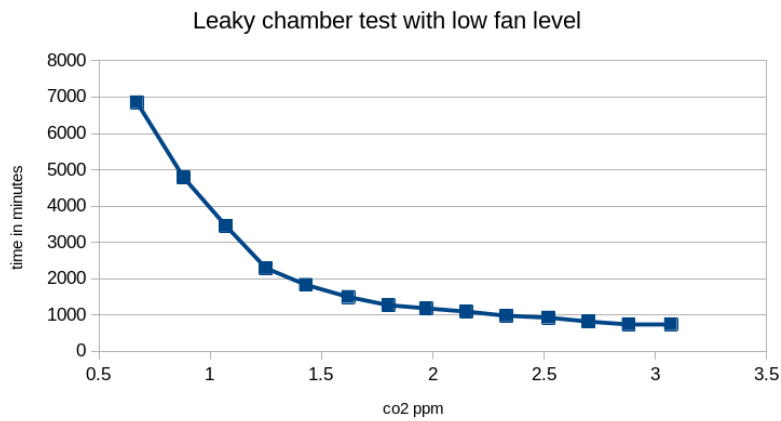
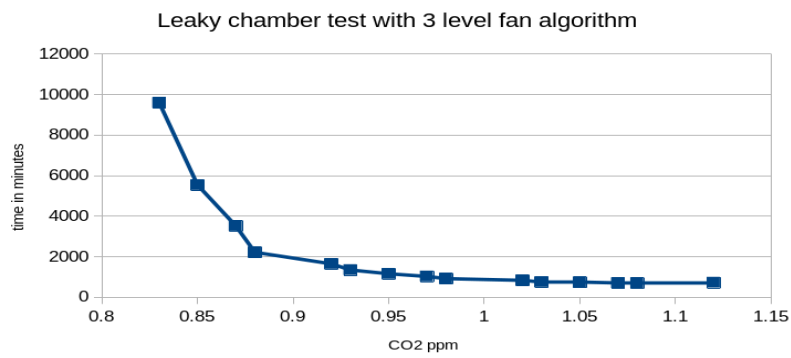
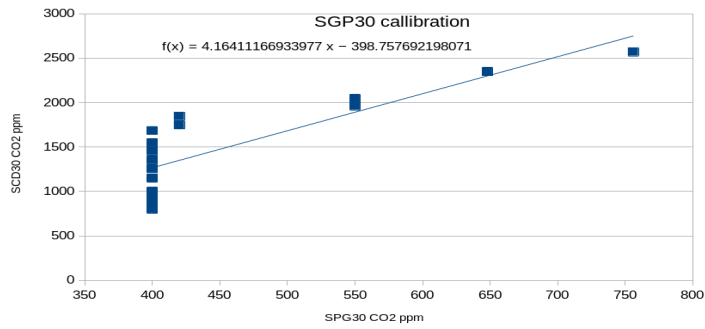
High humidity and CO2 level is not a problem for real mechanical engineers! It's possible to normalize relative humidity by making good ventilation and optional we can design HVAC systems to manage humidity on buildings. Additionally, it will be important to know and regulate relative humidity accurately to choose the best rate for people inside the building. For example, <55% - is pleasant, 56-60% - comfortable, 61-65% - getting sticky, 66-70% uncomfortable, 71-75% - oppressive, 76% + is miserable. Solving problems with CO2 level is much easier. We need to make it possible for buildings to get outside air and exhaust inside air away from the inside of buildings. Here are some examples of CO2 level means: 400-600 - excellent, 700-1000 - fair, 1100 - 1500 mediocre and 1600 - 2100 - bad.

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Methods

I created the box with length – 318 mm, width – 143 mm, height – 100mm and volume = 4.5 L. To create a circuit for the RH project I used a 5VDC fan, a low-cost microcontroller, 5VDC fan, SGP30, a bunch of wires, resistors, one diode, one transistor and OLED display. 5VDC is connected to 5V and controlled by an Adafruit pin using a transistor. OLED display connected to 3.3V. The display is showing current temperature in Celsius, current relative humidity, status of fan, and event time from the start of the program. My deadband is 100 ppm. I chose it by calculating random error. Average ppm in my room was 800. Maximum with the same condition – 842. Minimum – 782. Sensor random error is around 40 ppm but I round it to 100 to make time with turned off or low level ventilation bigger for comfort and energy consumption. Data which I was using for this calculations you can see on the graph below. I used the method described in Lecture 13 to calibrate my sgp30 module. Using excel analog program I found out the calibration formula – $f(x) = 3 * x + 500$. You can see the graph which I was using for calibration below. I did the DCV control algorithm. I connected an adafruit output signal to a transistor which controls 5V 2A electricity which goes to the fan. I conducted a leaky chamber test where CO2 is elevated and allowed to “decay” to background room condition with the fan persistently set to “low” fan speed. Graph you can see below. I also conducted a leaky test where CO2 is substantially elevated (well above your high DCV ventilation conditions) and the three-speed DCV control algorithm is operational. Graph you can see below.

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Results

I successfully did all the functions that I wanted to do. My “smart” box controls the co2 level and makes it lower when necessary. Moreover, the display in real time is showing current temperature in calcium, current relative humidity, status of fan, CO2 level and time from the start.

Conclusion

According to the experiments above, I can make the conclusion that the arduino sketch and box works as designed and it shows very good results, because with the 3 level fan algorithm co2 level decreased much faster (~ 2 times). Fan use high mode than co2 level is above co2max value + deadband, medium than co2 level less than co2max + deadband and higher than co2normal, low mode in other scenarios.

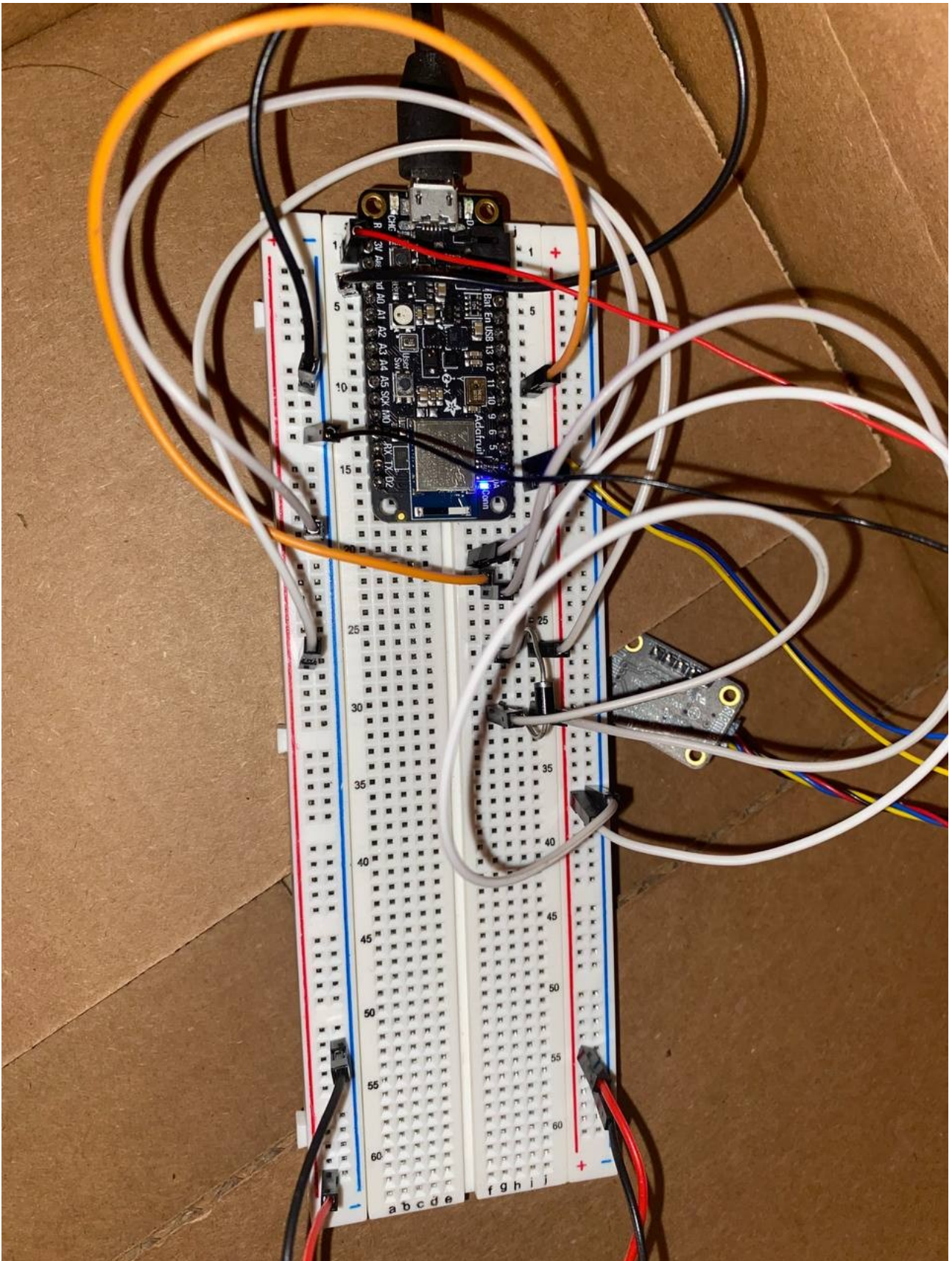
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Attached photos

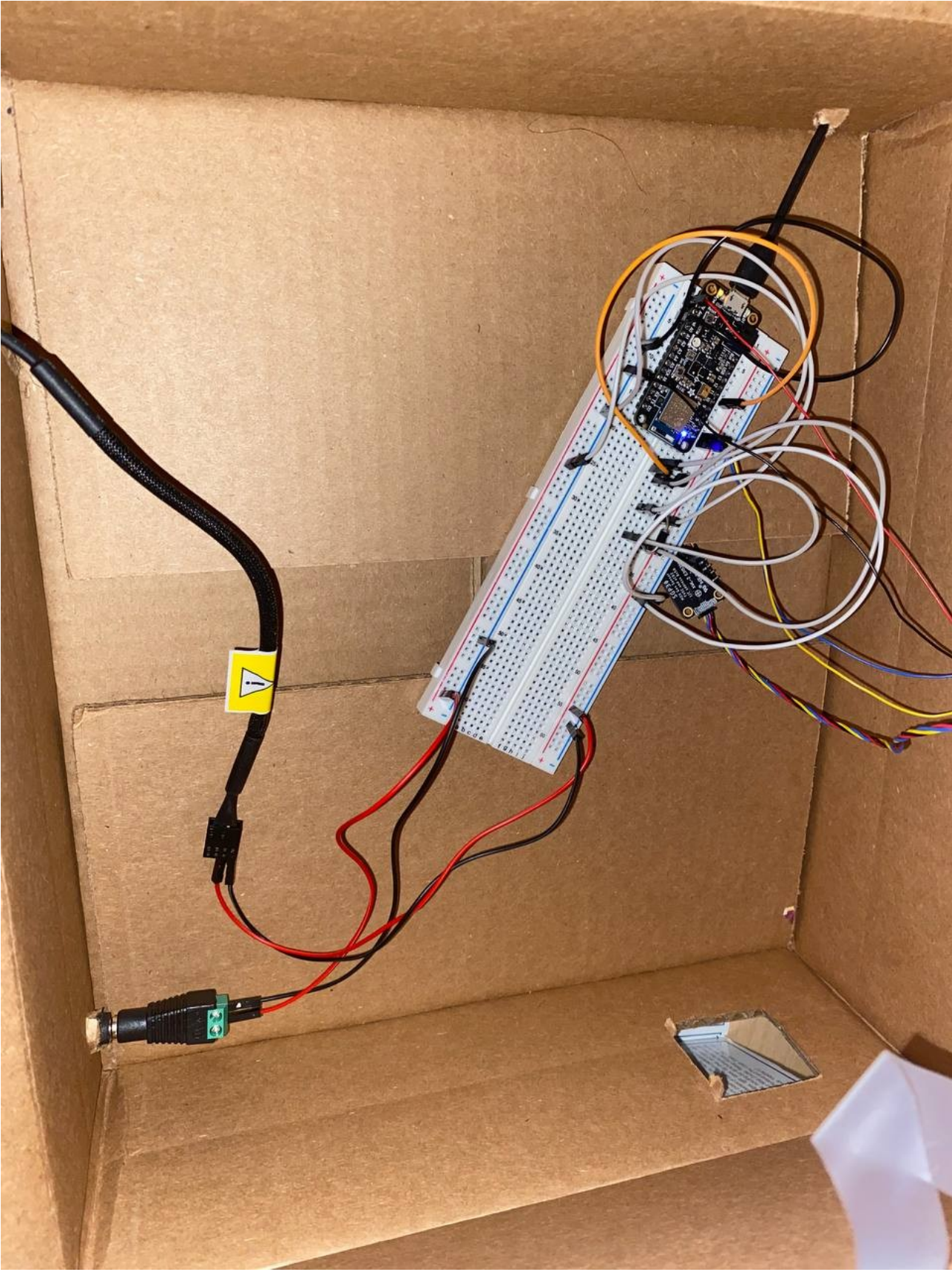


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