CRAFTING FORENSIC TOOLS FROM SCRATCH WITH ARDUINO

CLAY ALLRED

BUREAU OF ALCOHOL TOBACCO FIREARMS AND EXPLOSIVES (ATF)

FORENSIC SCIENCE LAB - ATLANTA

OPINIONS STATEMENT

Points of view or opinions contained in this publication are those of the author and do not necessarily represent the official position or policies of the U.S. Department of Justice or the Bureau of Alcohol Tobacco Firearms and Explosives. References to specific agencies, companies, products, or services should not be considered an endorsement by the author or the U.S. Department of Justice. Rather, the references are illustrations to supplement discussion of the issues.

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- Consult an expert before attempting anything contained within.

WHAT IS ARDUINO

- **Arduino** (/ɑːrˈdwiːnoʊ/) is an open-source hardware and software company, project and user community that designs and manufactures single-board microcontrollers and microcontroller kits for building digital devices.
  - Source: Wikipedia.org
- Arduino™ refers to a specific company and line of products: generic Arduino-style products are referenced in this talk

ARDUINO HISTORY

- The Arduino project began in 2005 as a tool for students at the Interaction Design Institute Ivrea in Ivrea, Italy.
- The goal was to provide a low-cost, simple way for novices and professionals to create devices that interact with their environment using sensors and actuators
- The name *Arduino* comes from a bar in Ivrea, Italy
  - Source: Wikipedia.org

WHAT CAN I DO WITH AN ARDUINO?

- Robotics
  - Automating repetitive tasks

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  - Sprinkler control
  - Remote control anything
  - Connect motion sensors to lights

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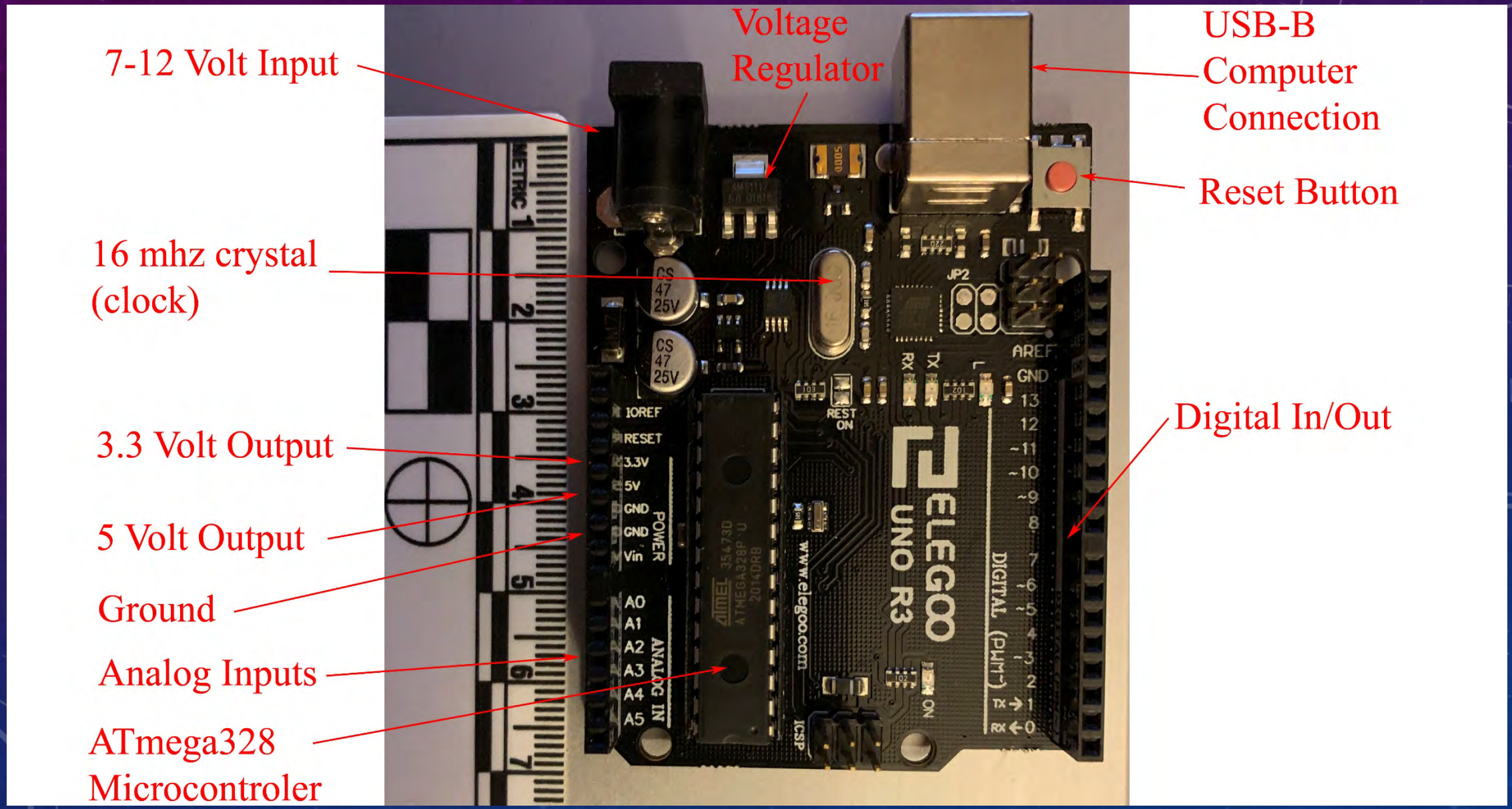
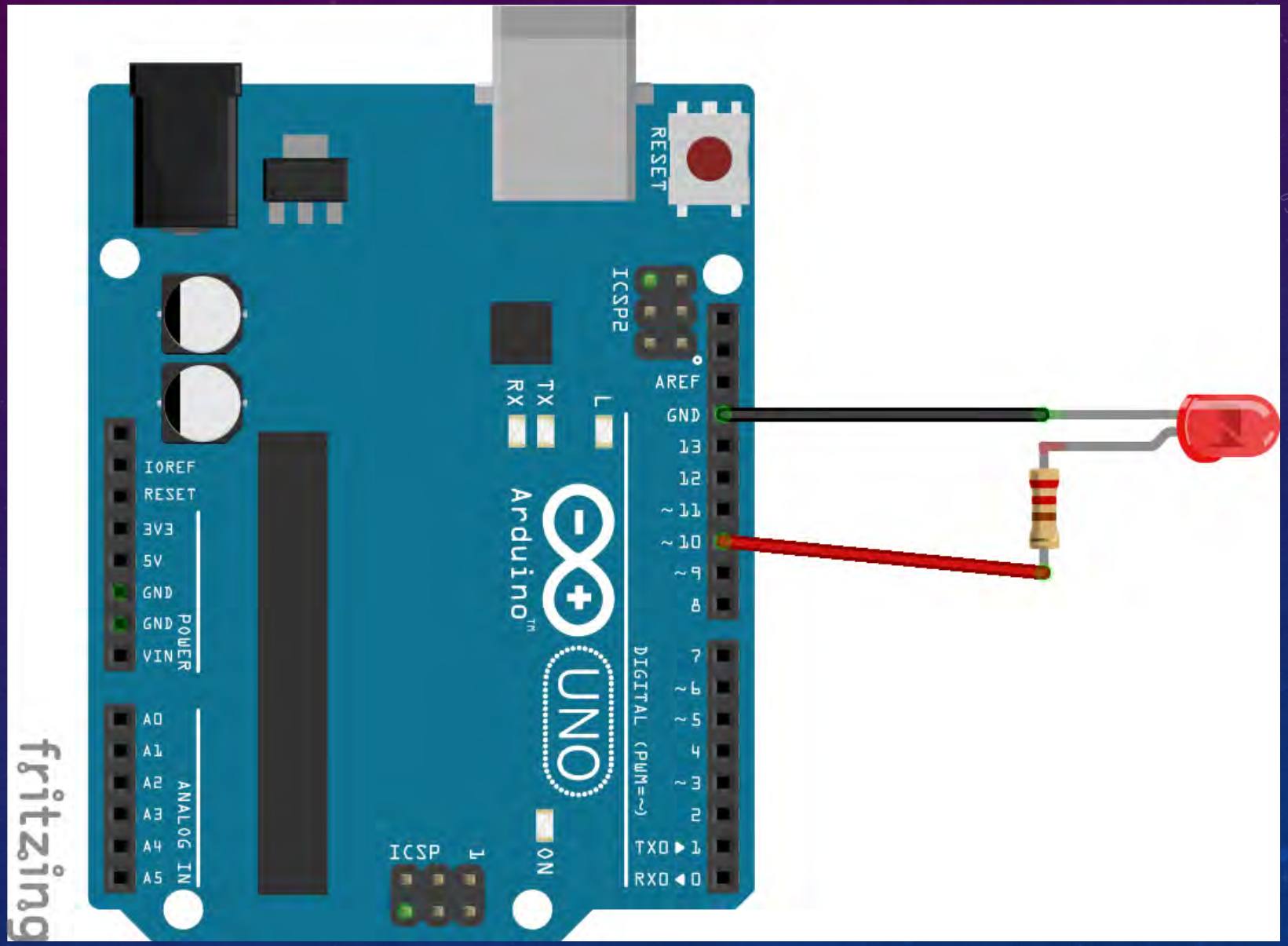
- Change/modify/enhance any existing product that uses a battery or electrical plug
- A lot of other crazy stuff – Just google Arduino Projects

GENERAL LAYOUT: ARDUINO R3 – STYLE BOARDS



CREATING A BLINKING LED



CREATING A BLINKING LED

sketch_jan24a | Arduino 1.8.13

File Edit Sketch Tools Help

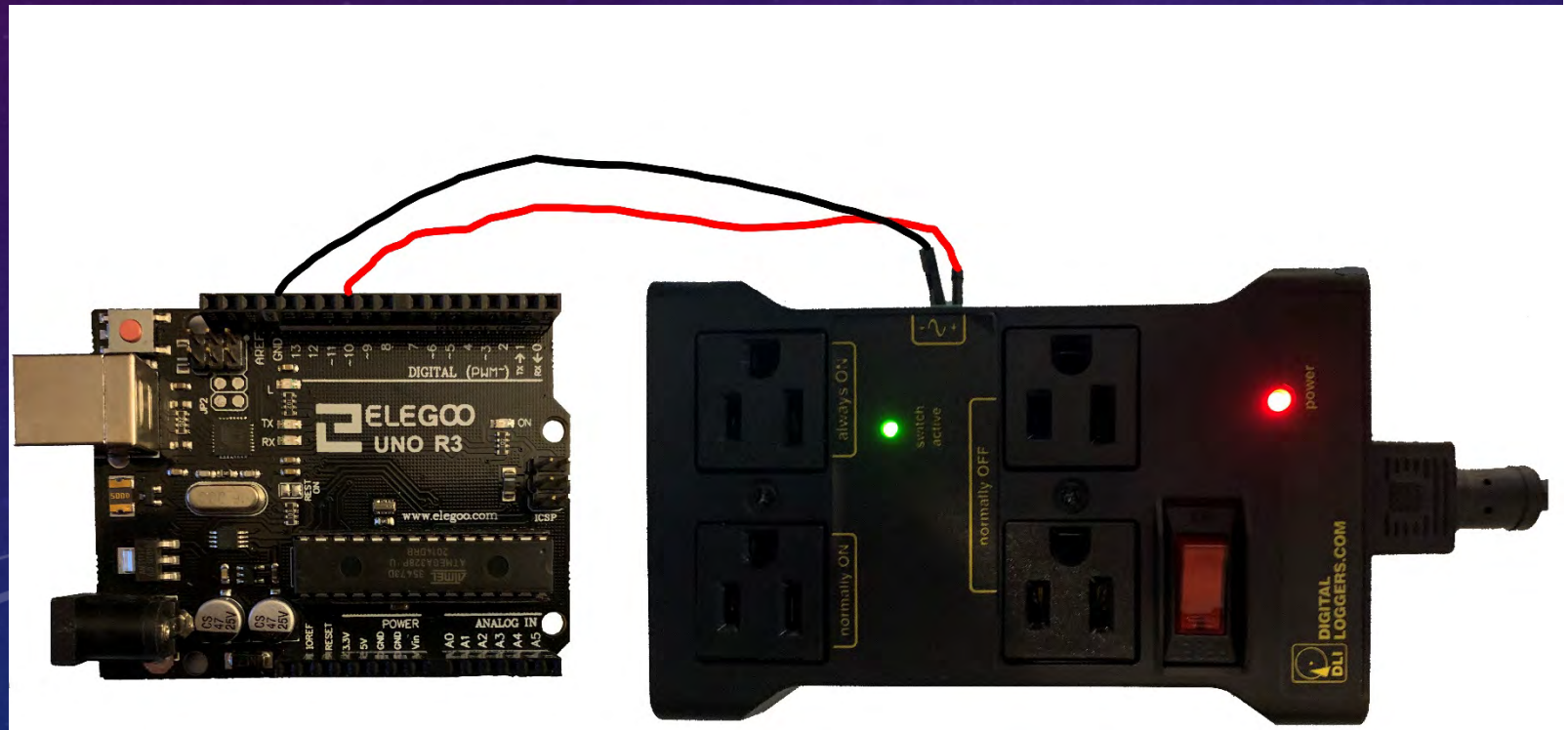
sketch_jan24a §

```
void setup() {
  //assign pin 10 as an output
  pinMode (10, OUTPUT);

}

void loop() {

  digitalWrite(10, HIGH); //sending 5 volts to pin 10 to turn on the led
  delay (1000); //waiting with the LED on for 1000 ms (1 second)

  digitalWrite(10, LOW); //sending 0 volts to pin 10 to turn off the led
  delay (1000); //waiting with the LED off for 1000 ms (1 second)
}
```

CONTROLLING MORE THAN A 5 VOLT LED

- AC/DC Control Relay (IOTRELAY.COM)
- Has four (4) AC Plugs
  - 1 x Always on
  - 1 x Normally on
  - 2 x Normally off
- Has a 12 Amp thermal circuit safety breaker
- Contains an optically isolated relay
- Relay is rated for >400,000 operations at 30/40 Amps

ARDUINO AND RELAY TO CONTROL 110 V



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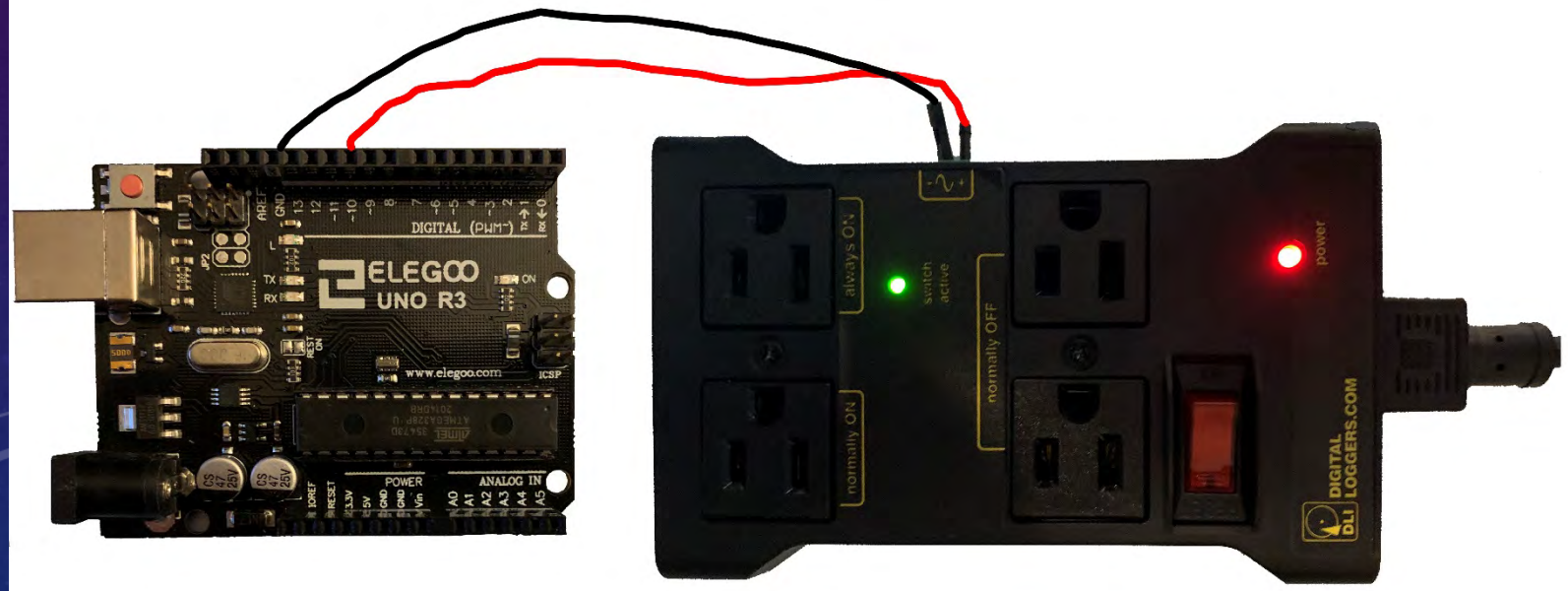

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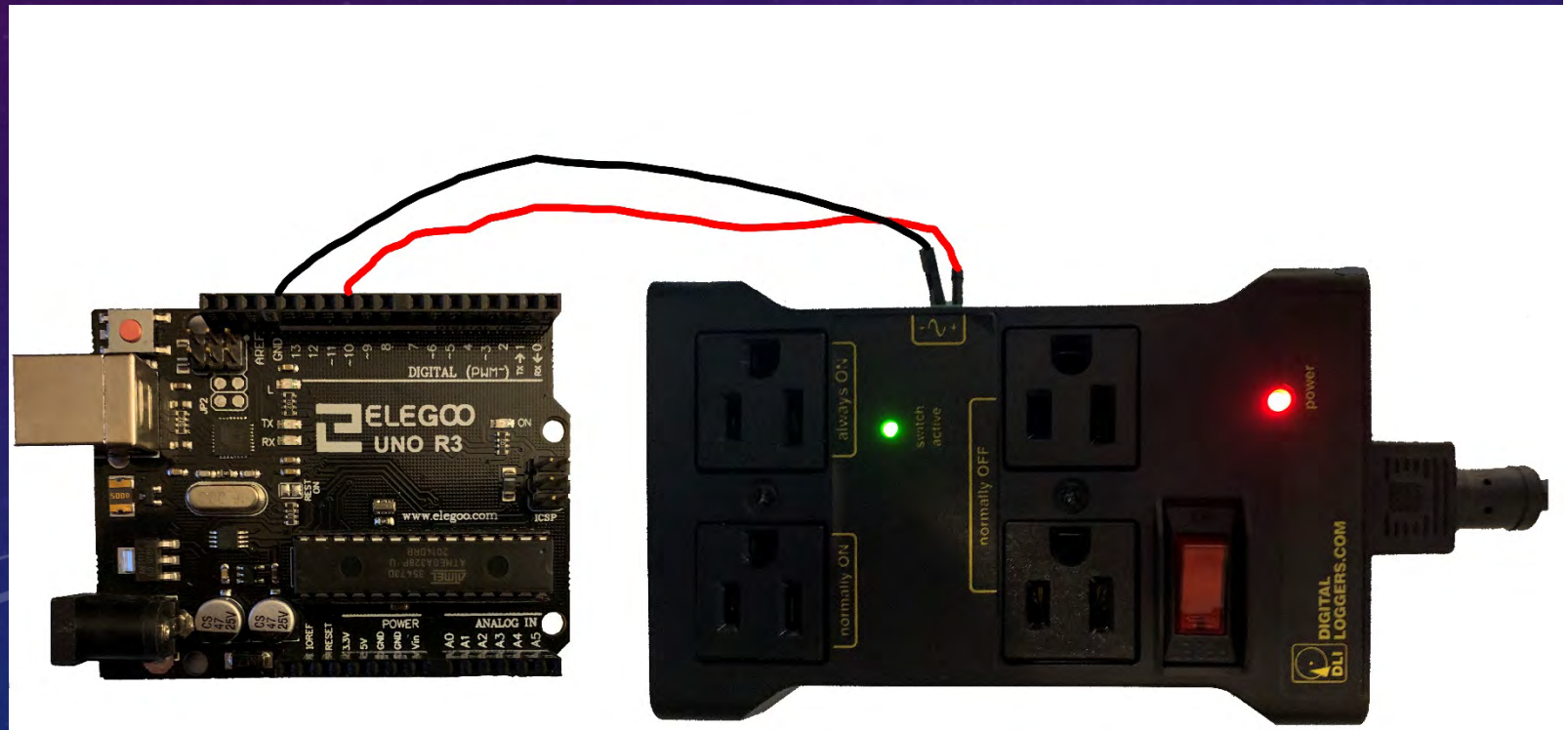

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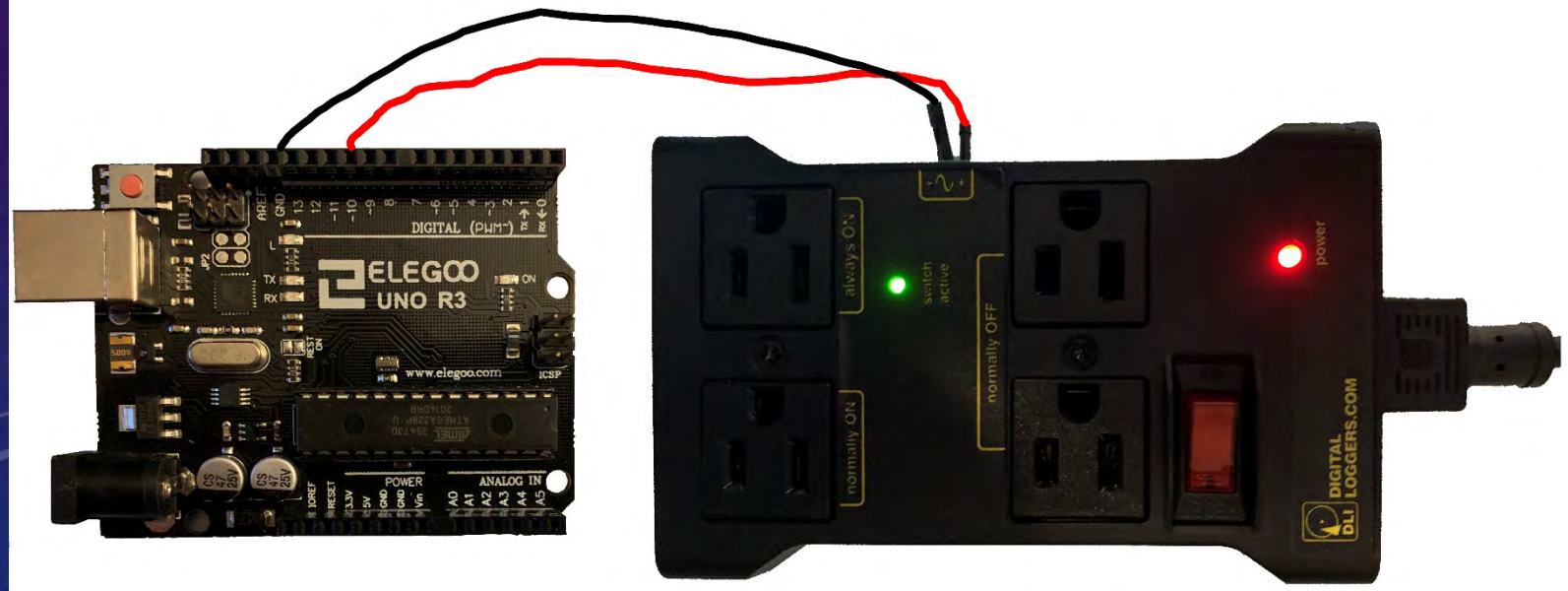

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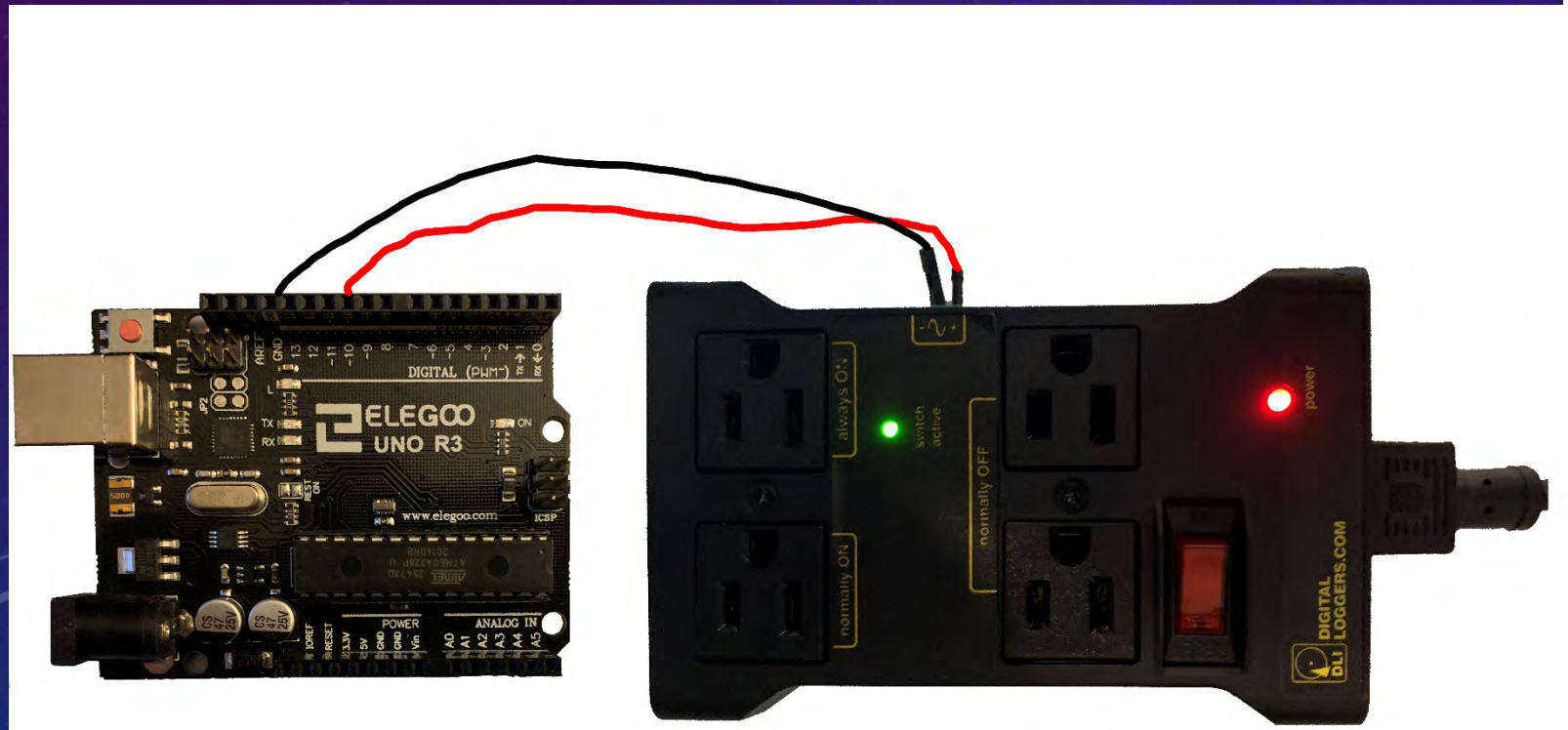

DHT22 TEMPERATURE AND HUMIDITY SENSOR

- **DHT22 Specifications**
- Operating Voltage: 3.5V to 5.5V
- Operating current: 0.3mA (measuring) 60uA (standby)
- Output: Serial data
- Temperature Range: -40°C to 80°C
- Humidity Range: 0% to 100%
- Resolution: Temperature and Humidity both are 16-bit
- Accuracy: ±0.5°C and ±1%

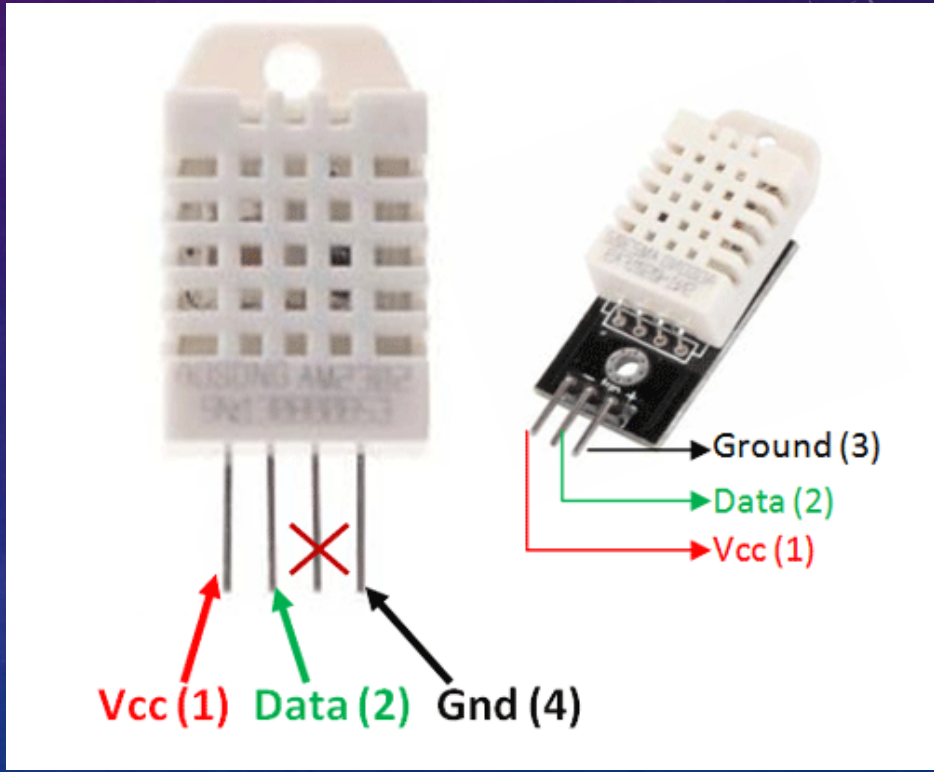

Image source: https://components101.com/sensors/dht22-pinout-specs-datasheet

1602 DISPLAY BOARD WITH I2C

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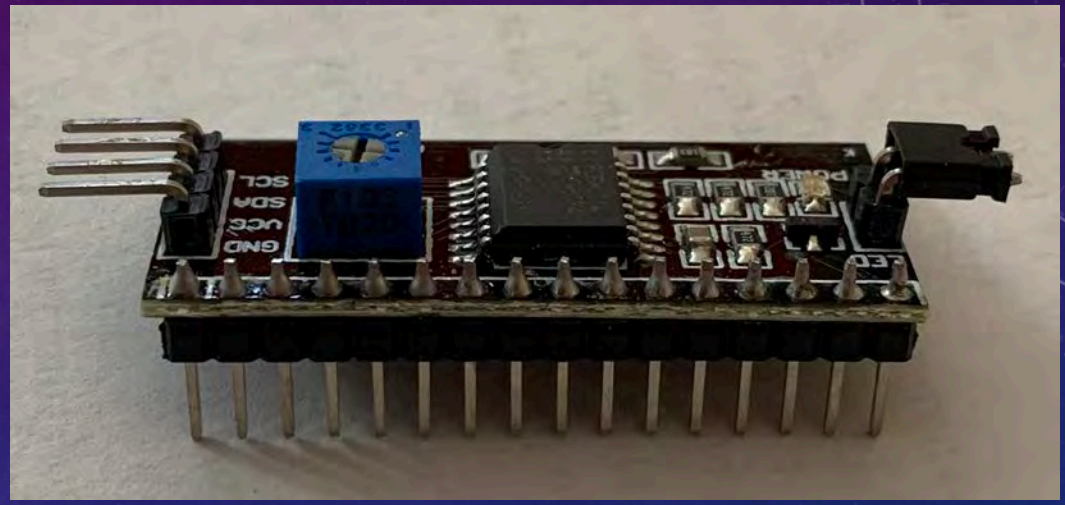

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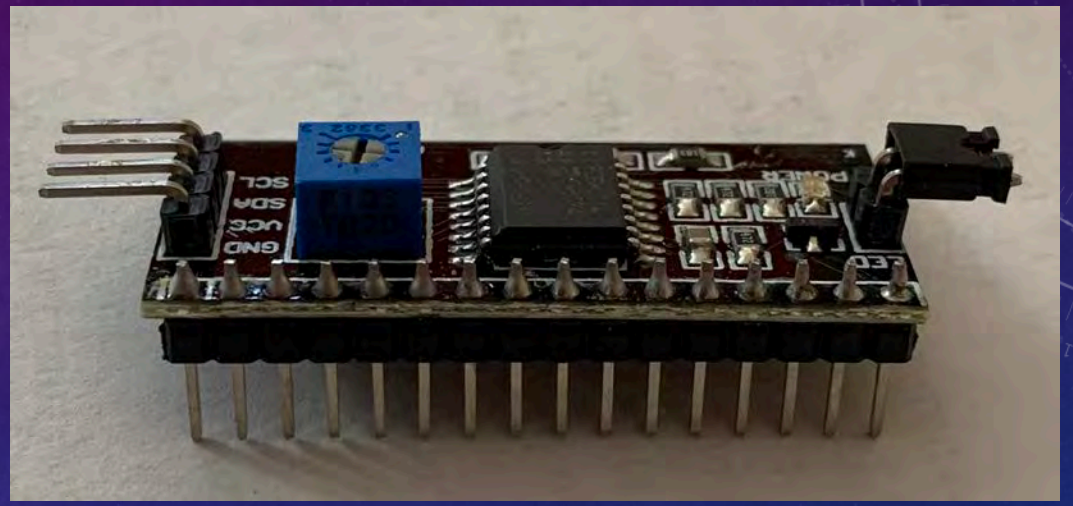

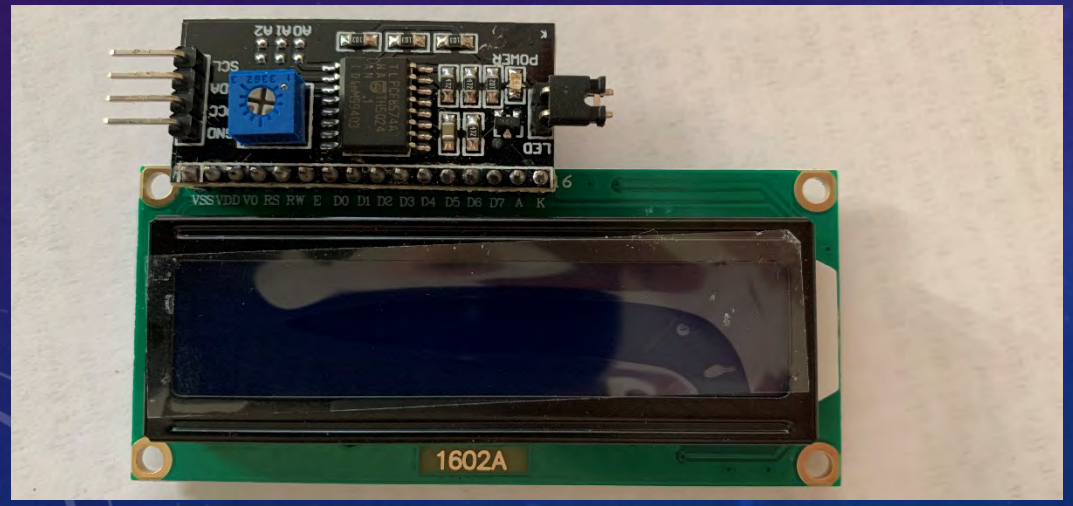

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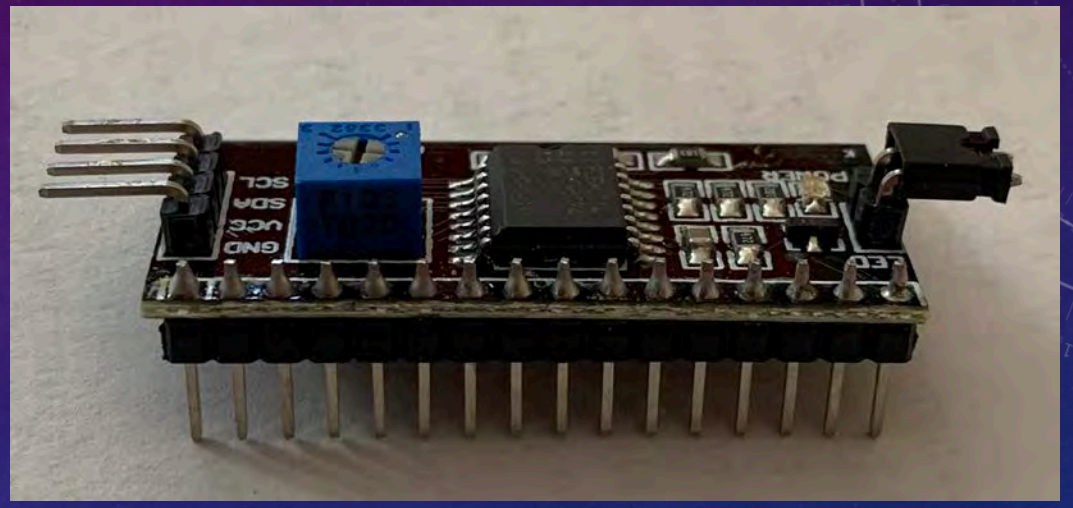

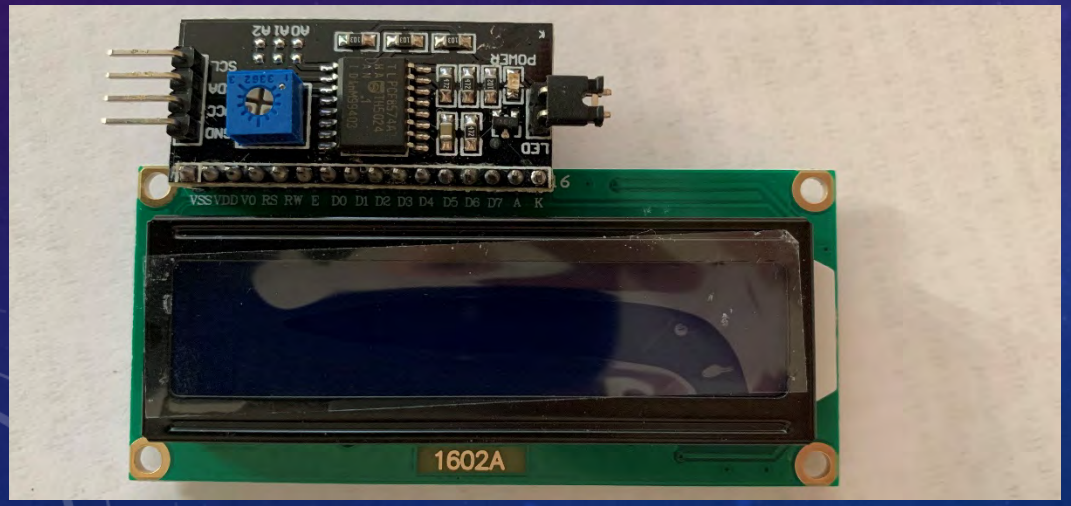

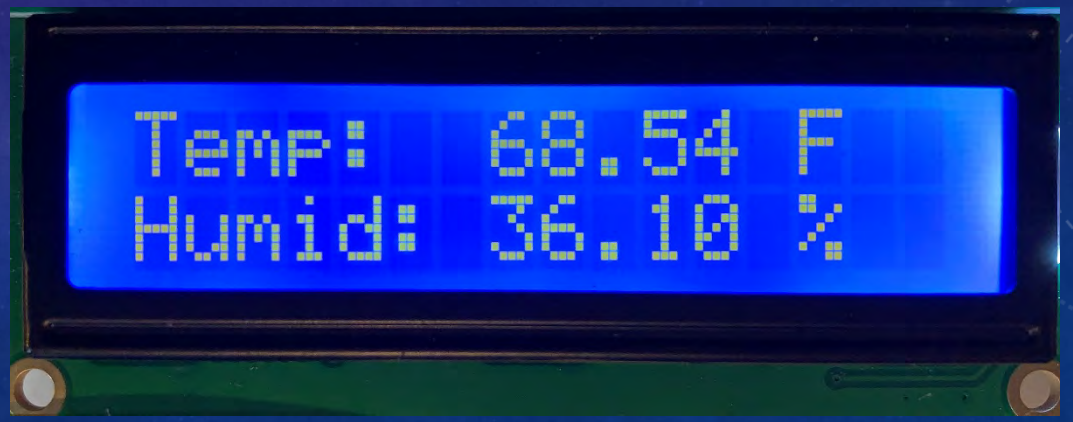

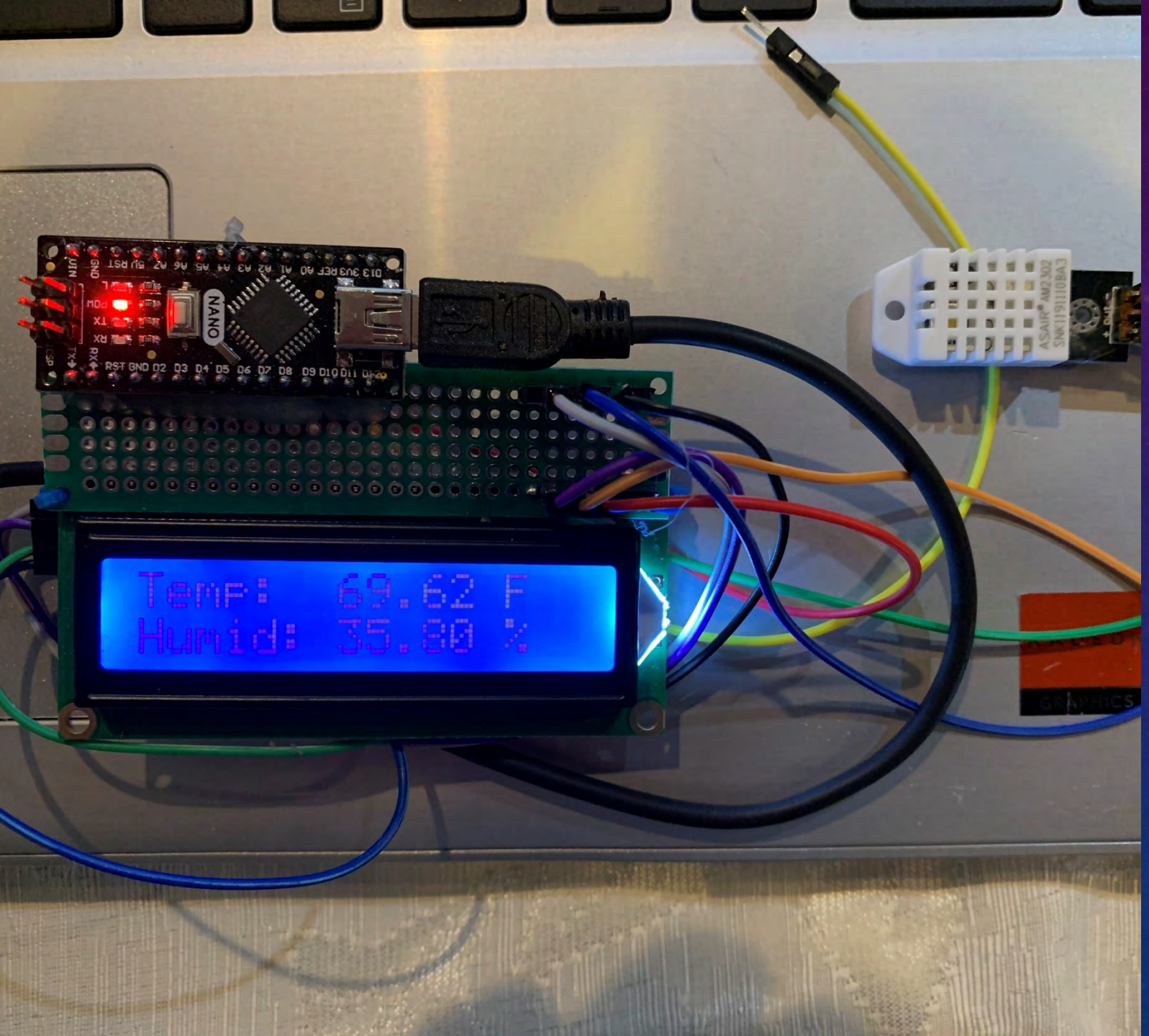

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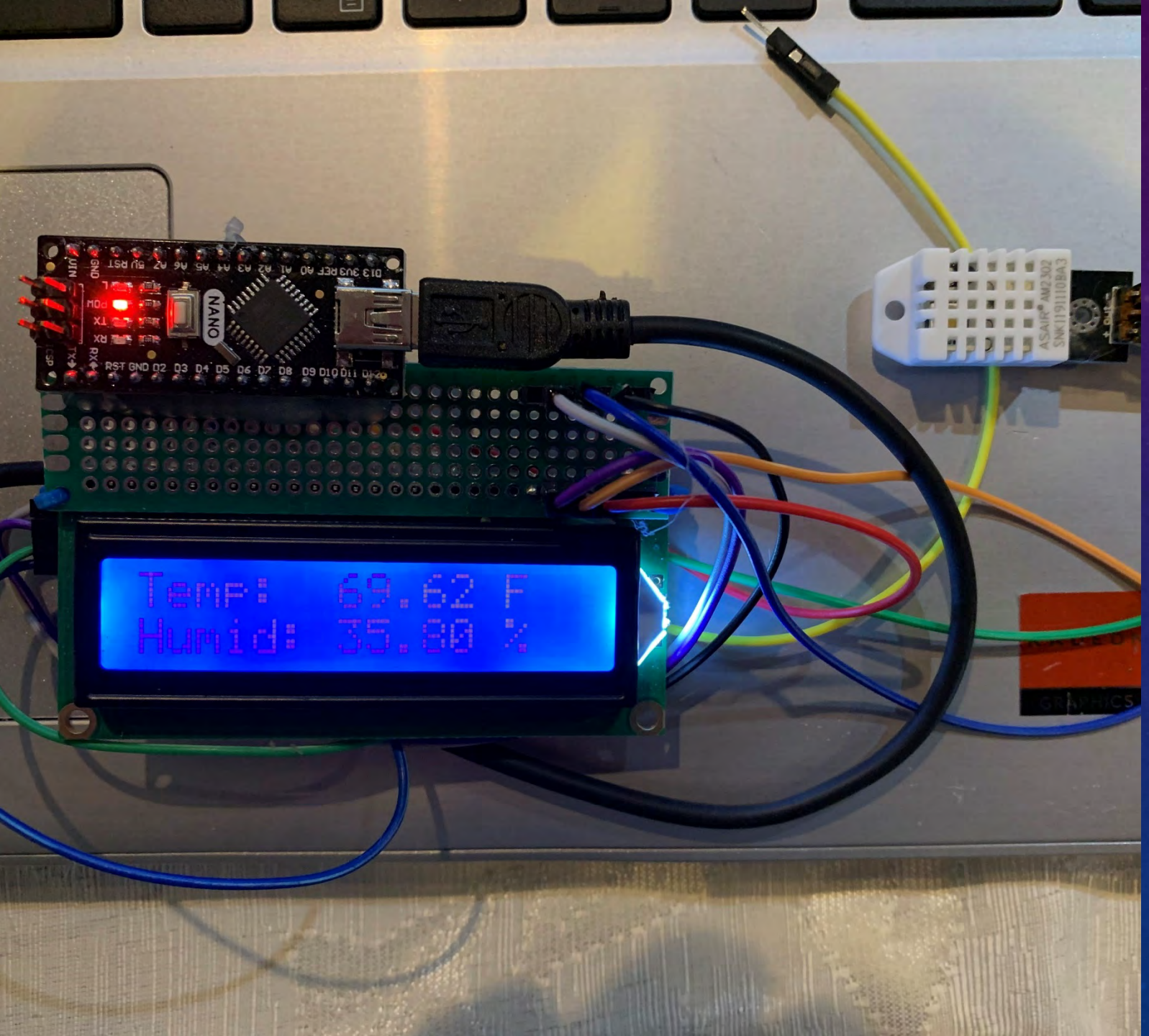

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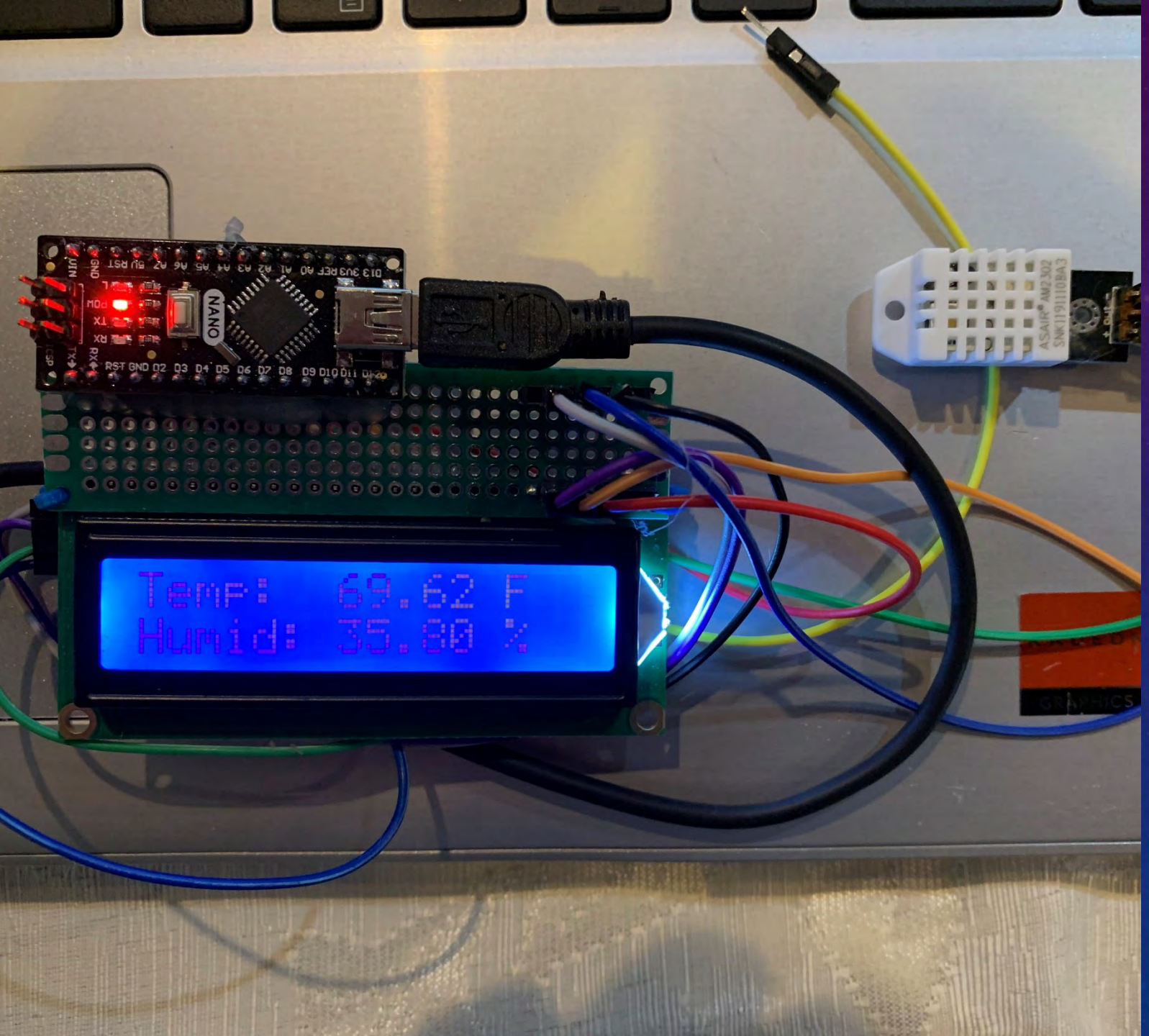
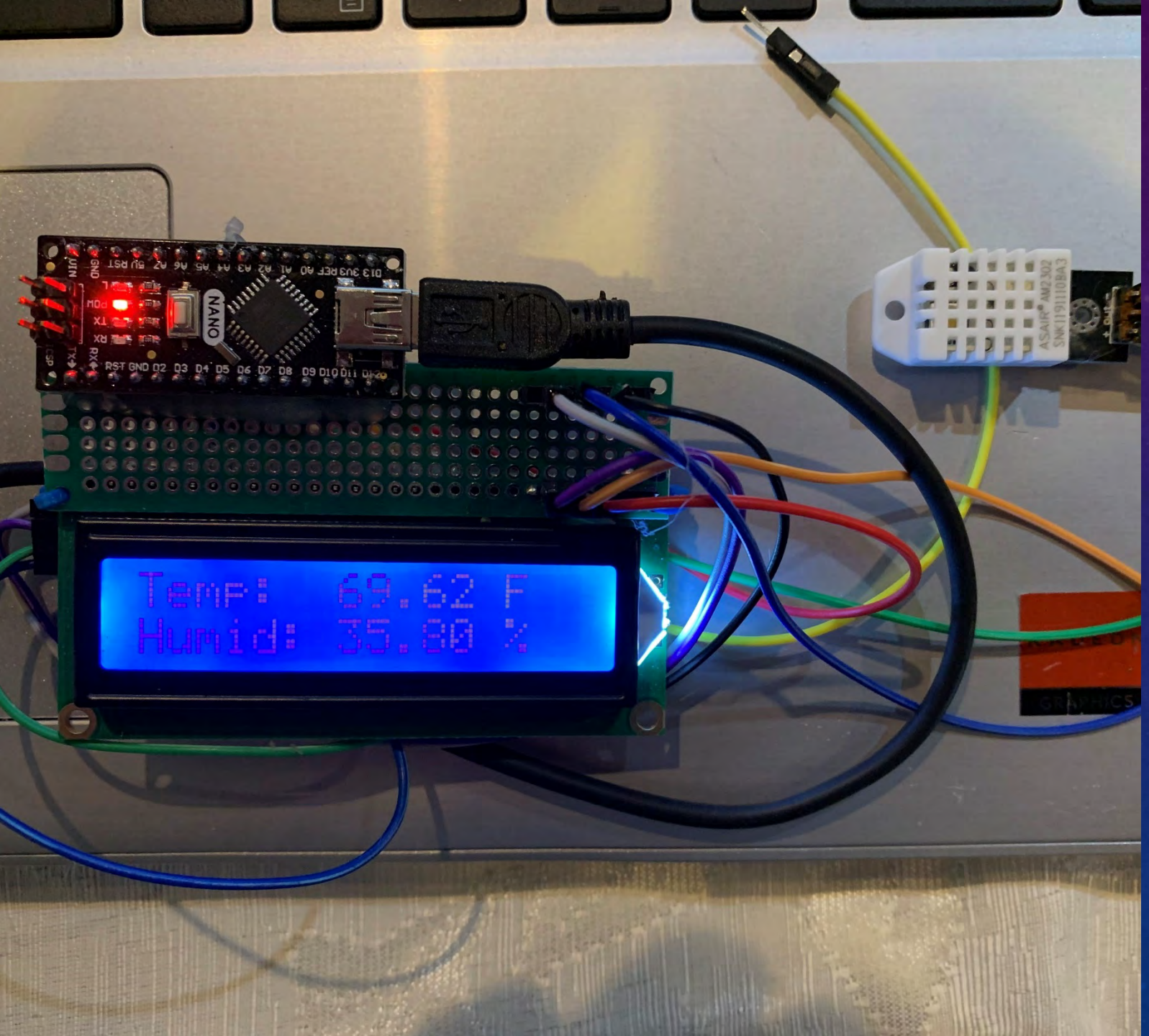
- The control module for a cigar humidor.



WHAT IS THIS THING?

- The control module for a cigar humidor.
- The start of a new career as a cantaloupe farmer.



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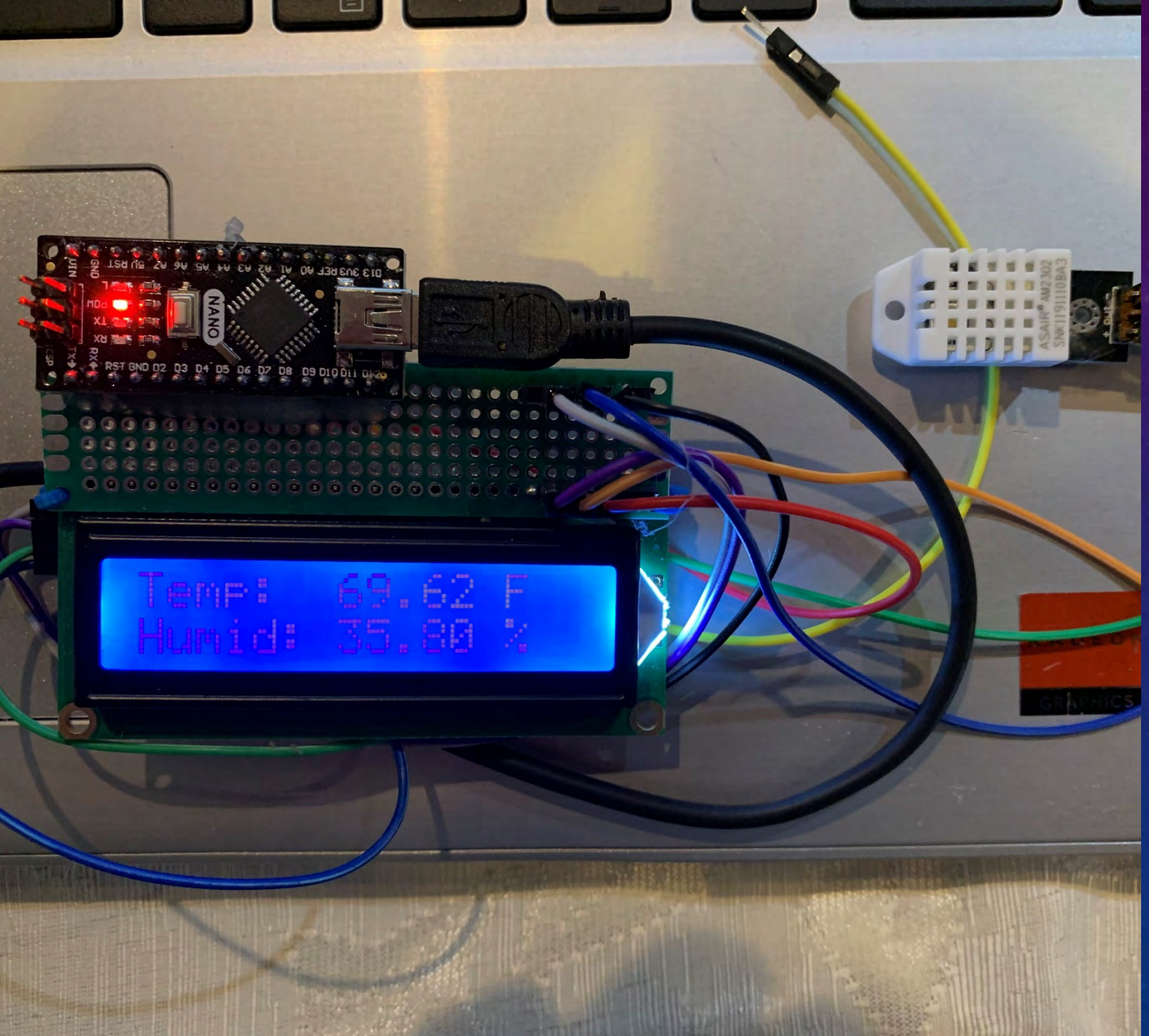
- The guts of a home weather station.



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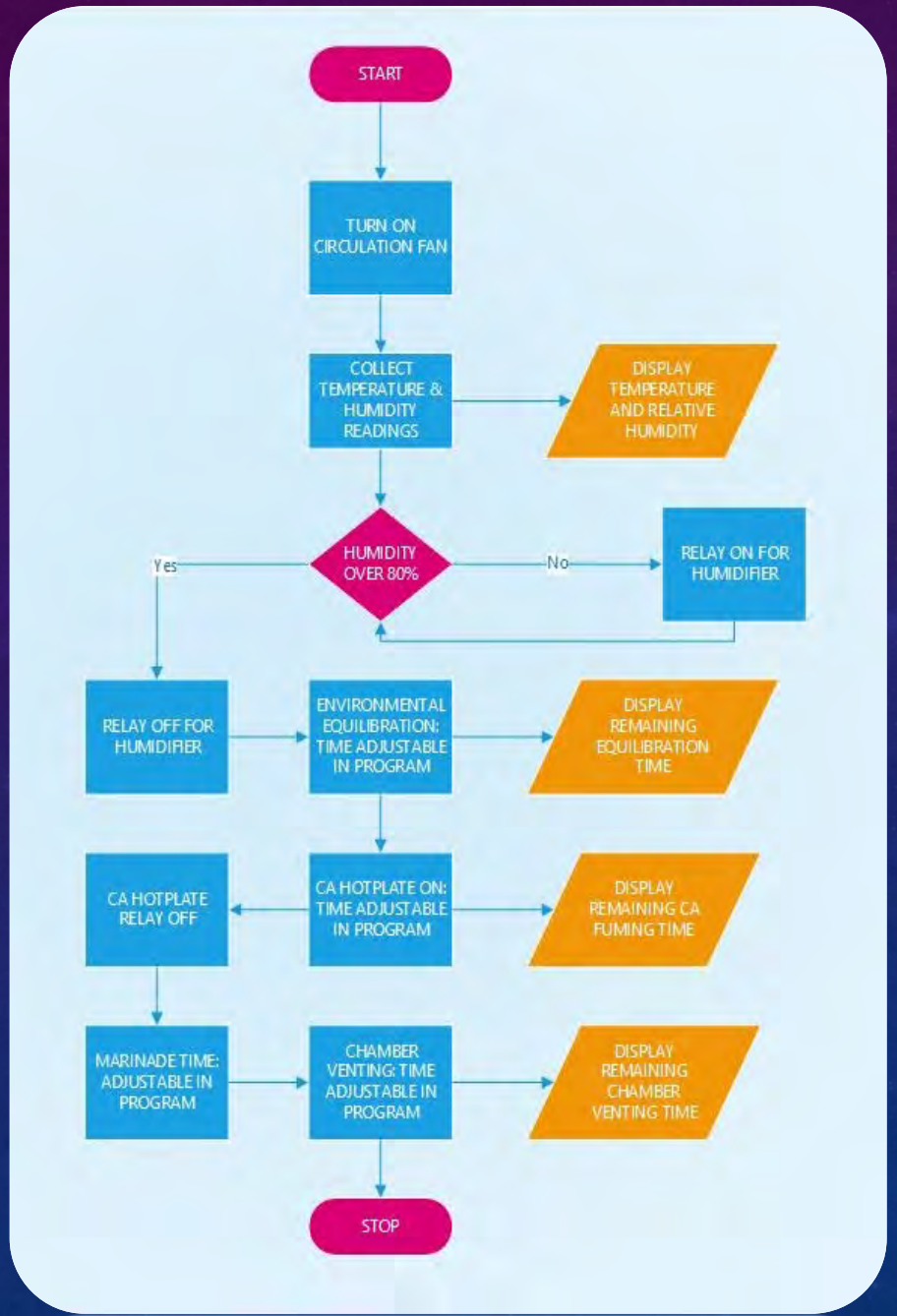
- The control module for a cigar humidor.
- The start of a new career as a cantaloupe farmer.
- The guts of a home weather station.
- All of the above.

BASIC CA CHAMBER PROCESS FLOWCHART



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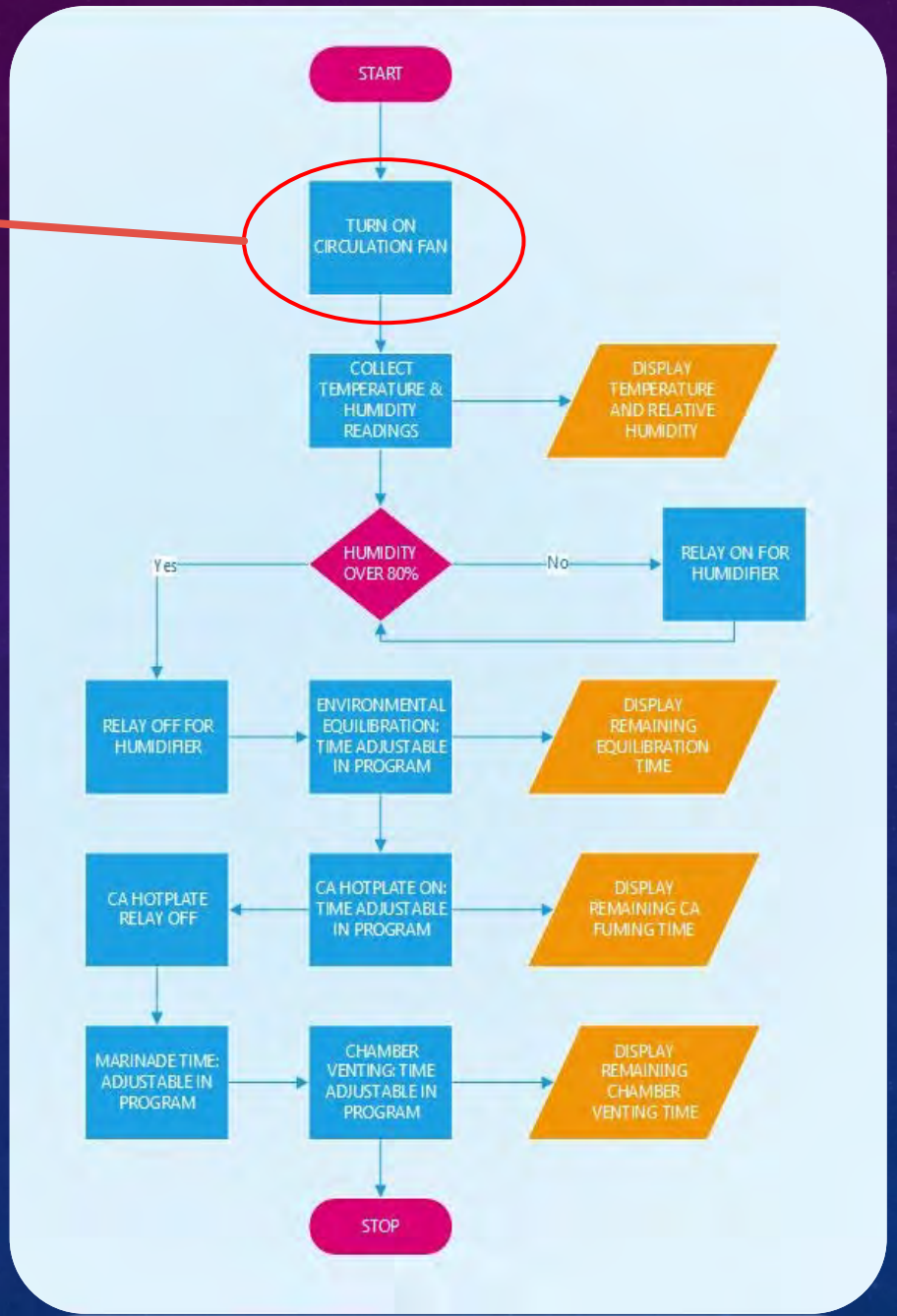

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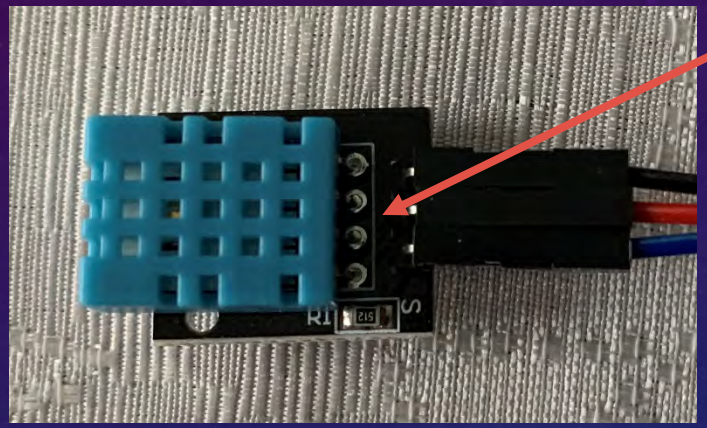

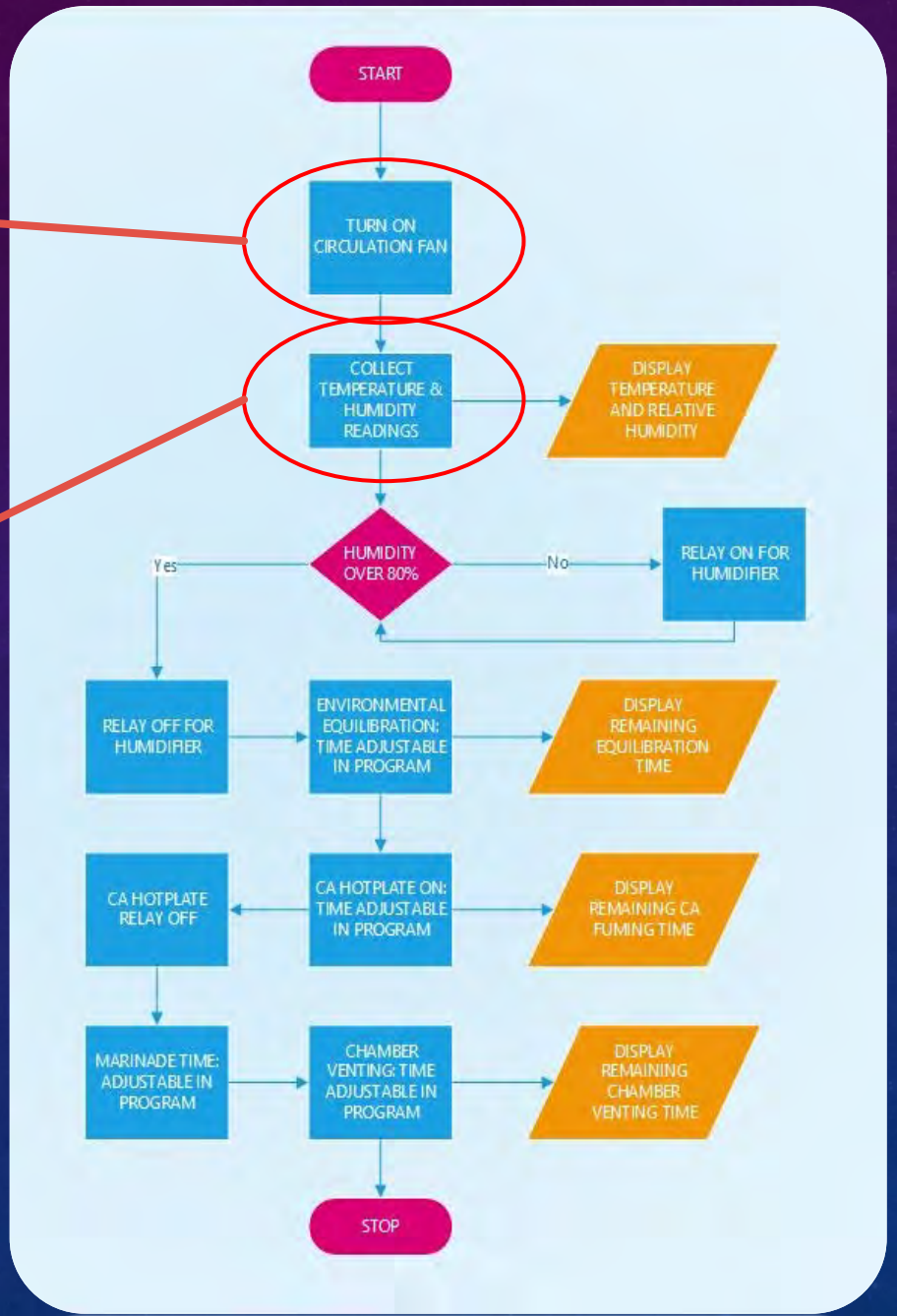

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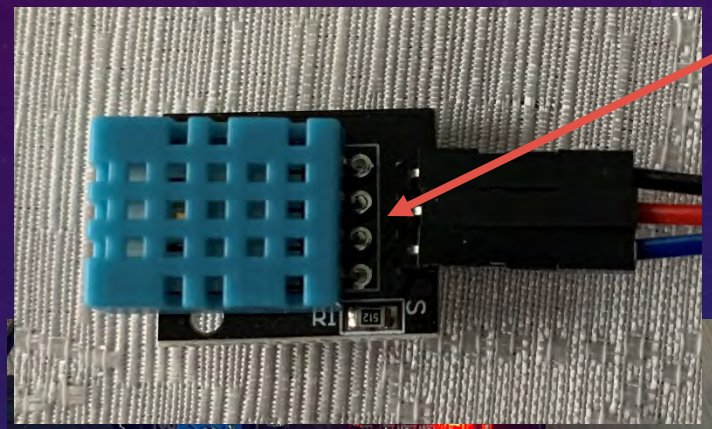

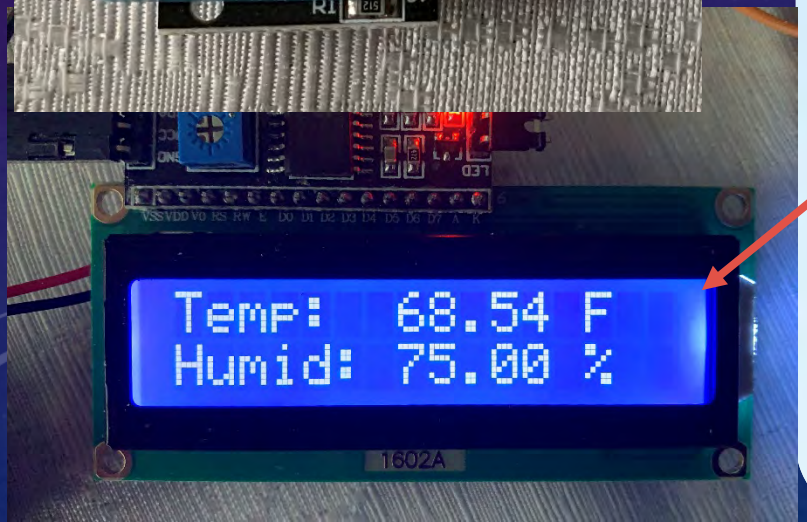

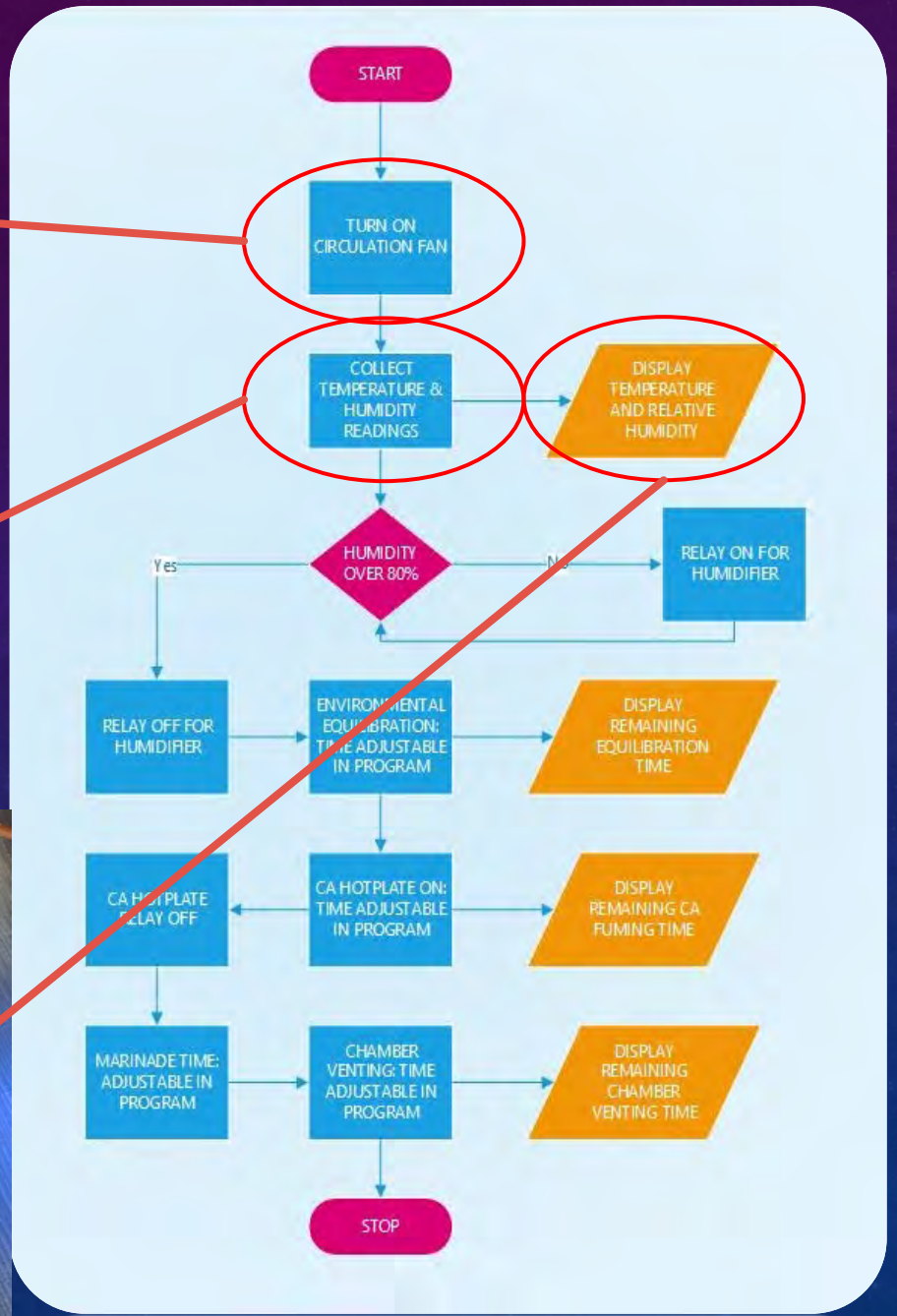

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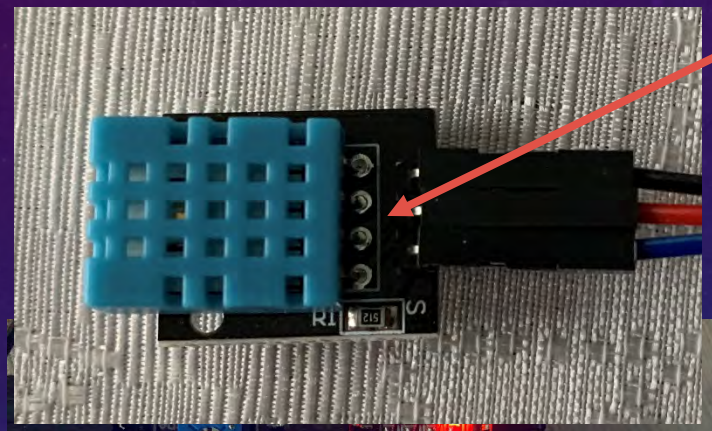

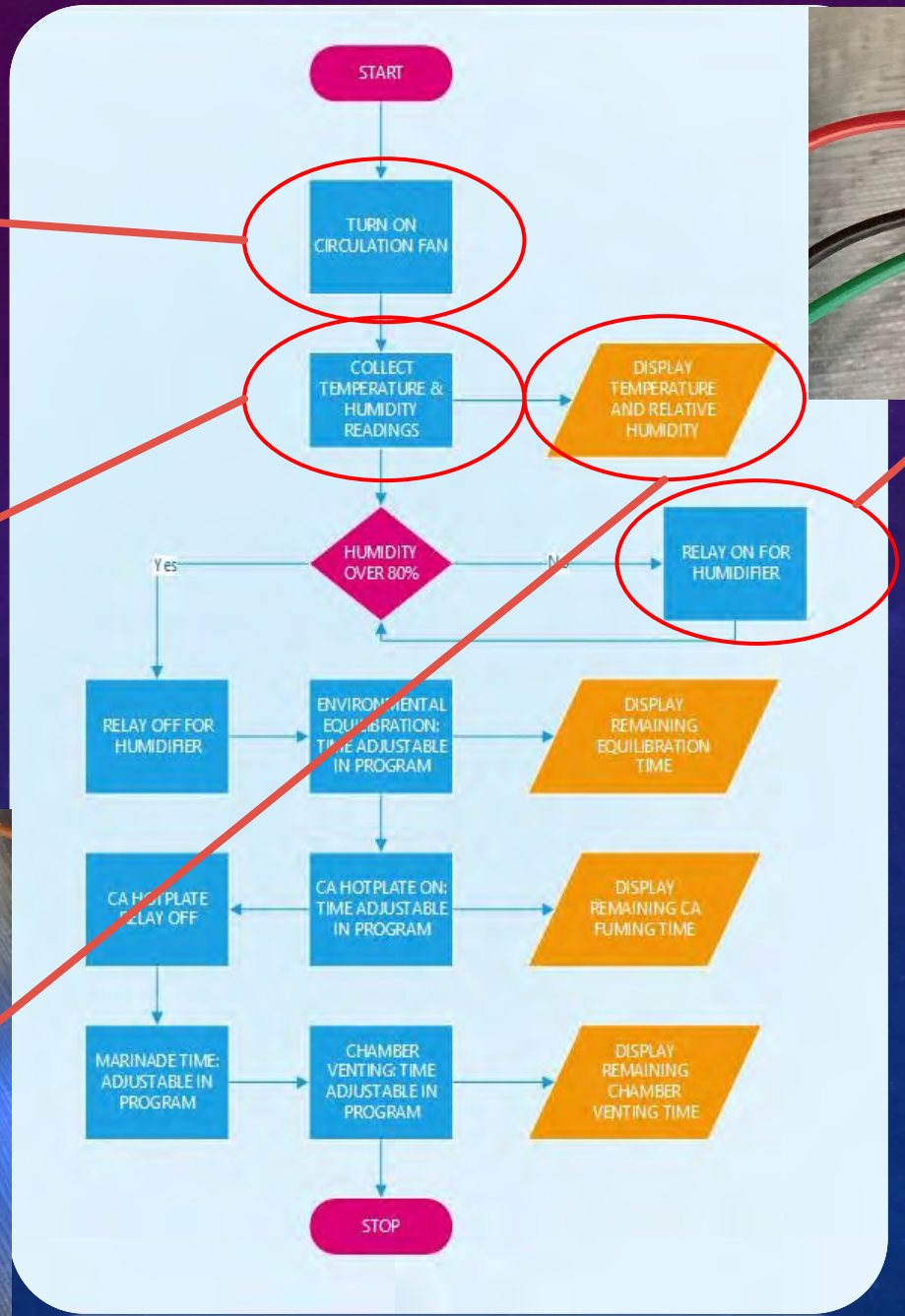

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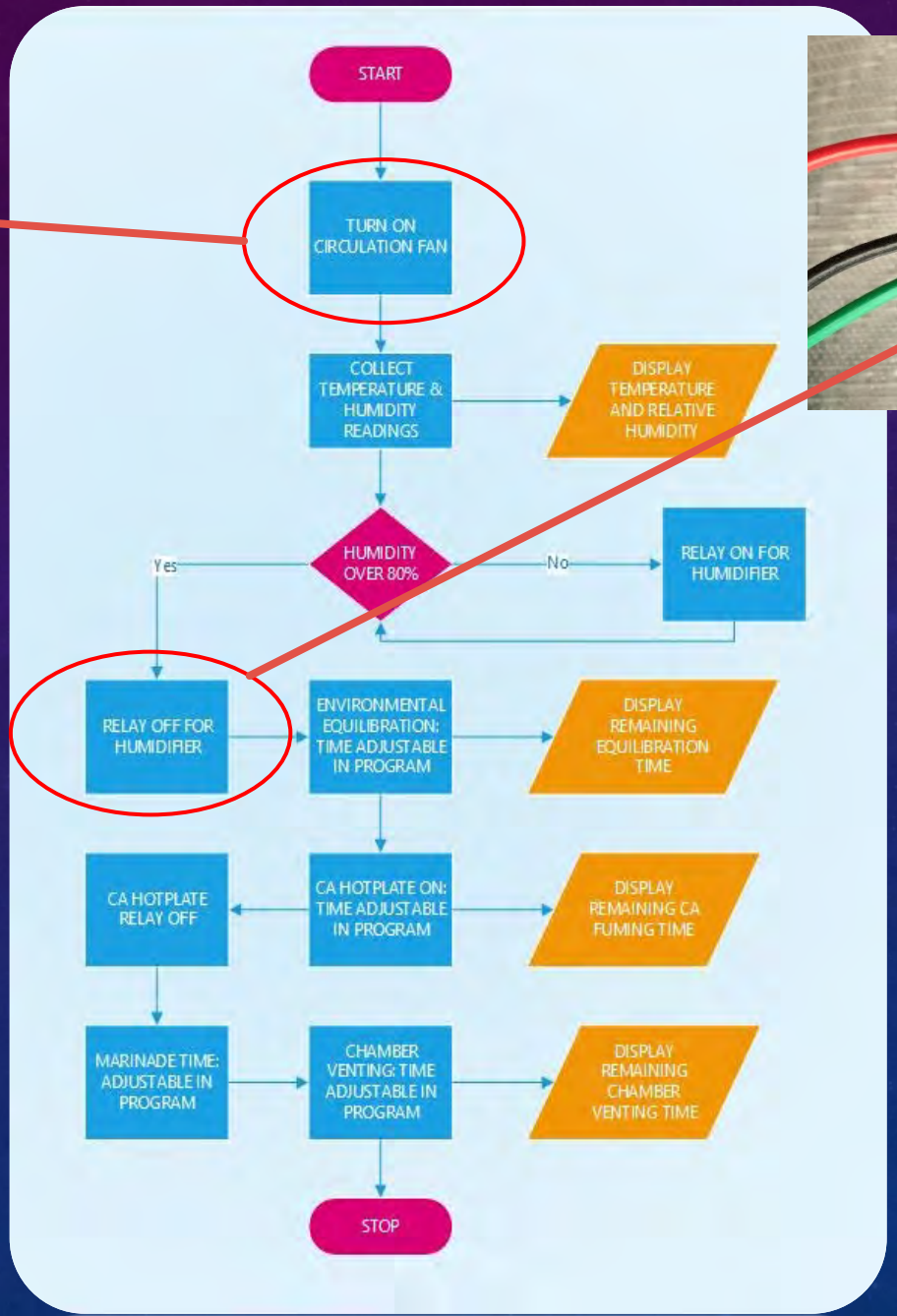

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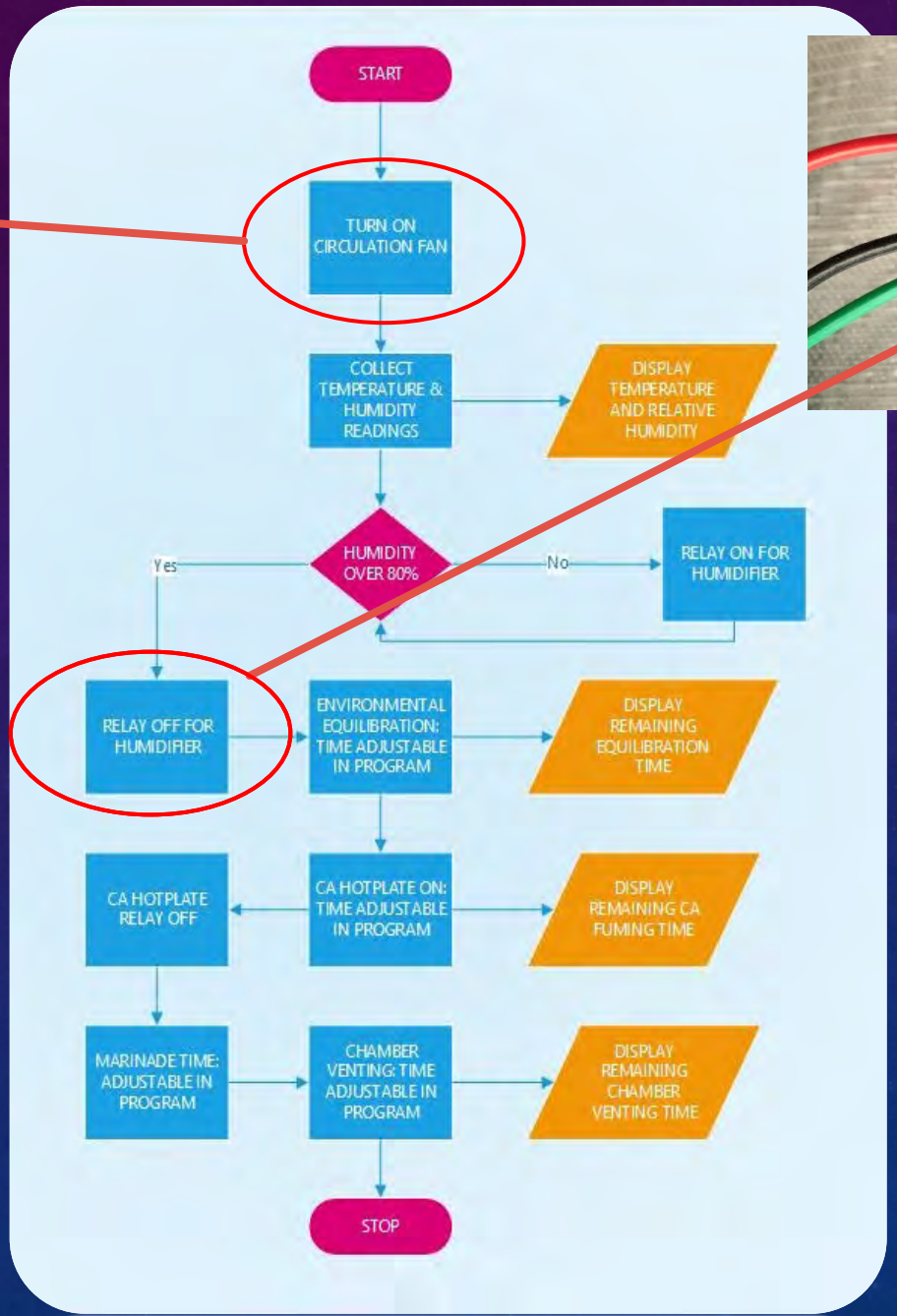

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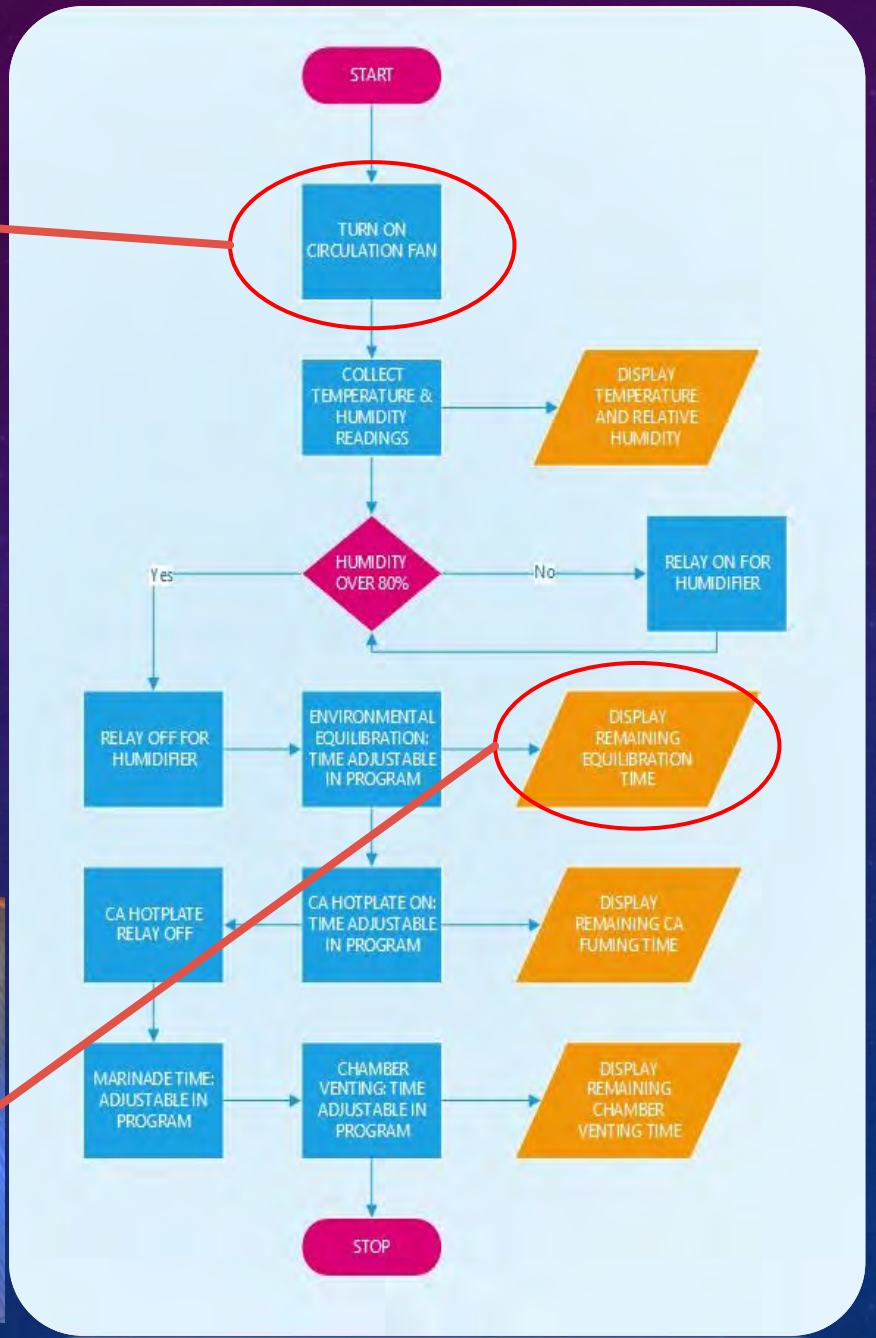

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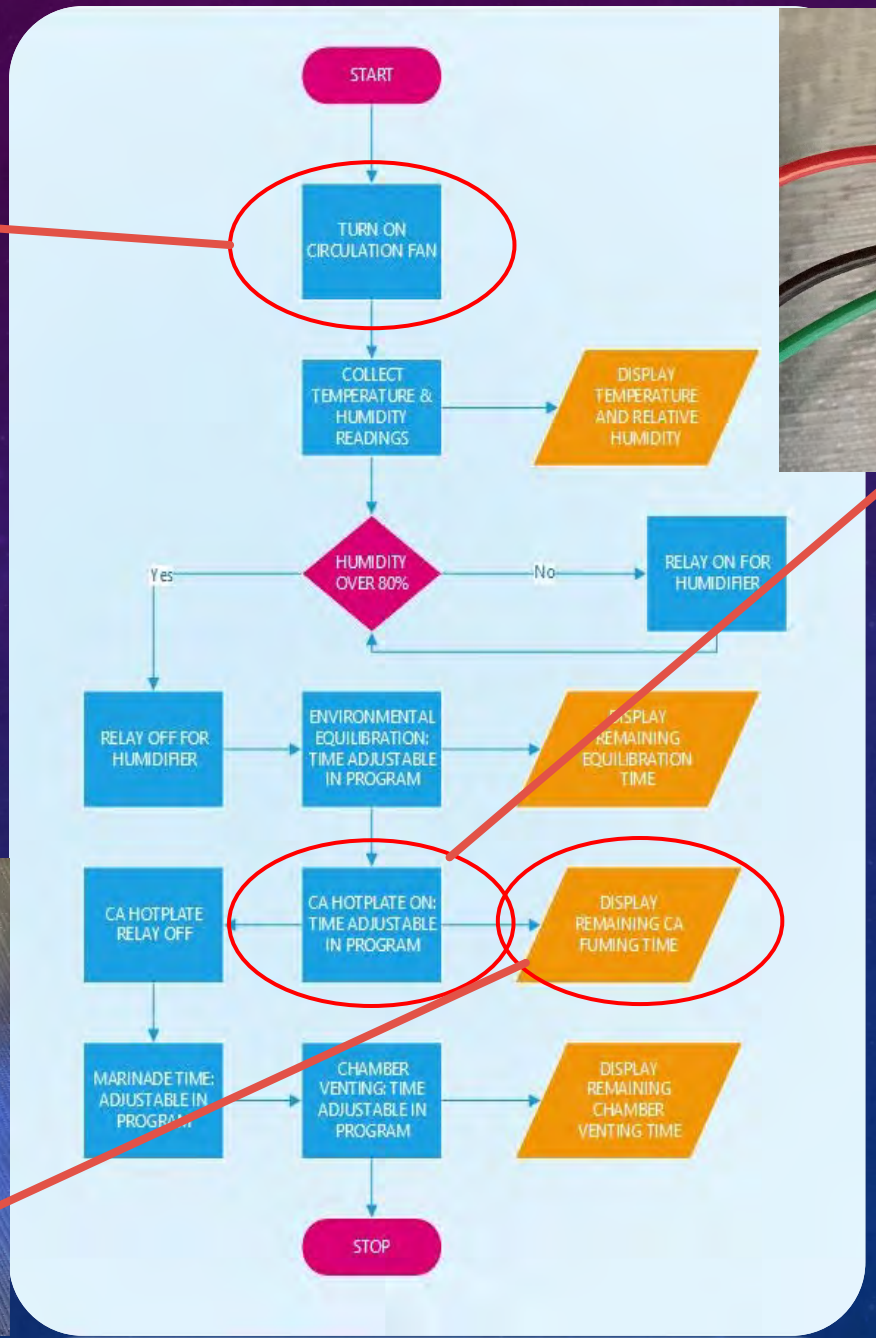

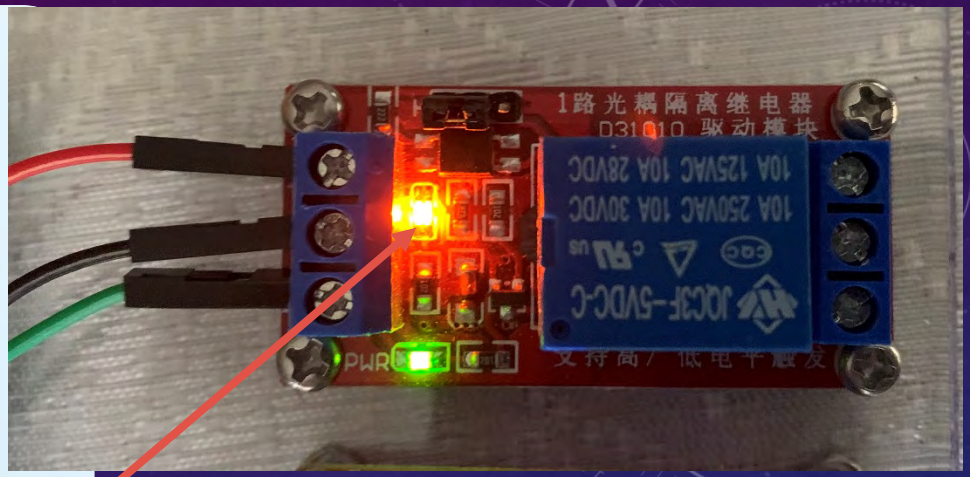

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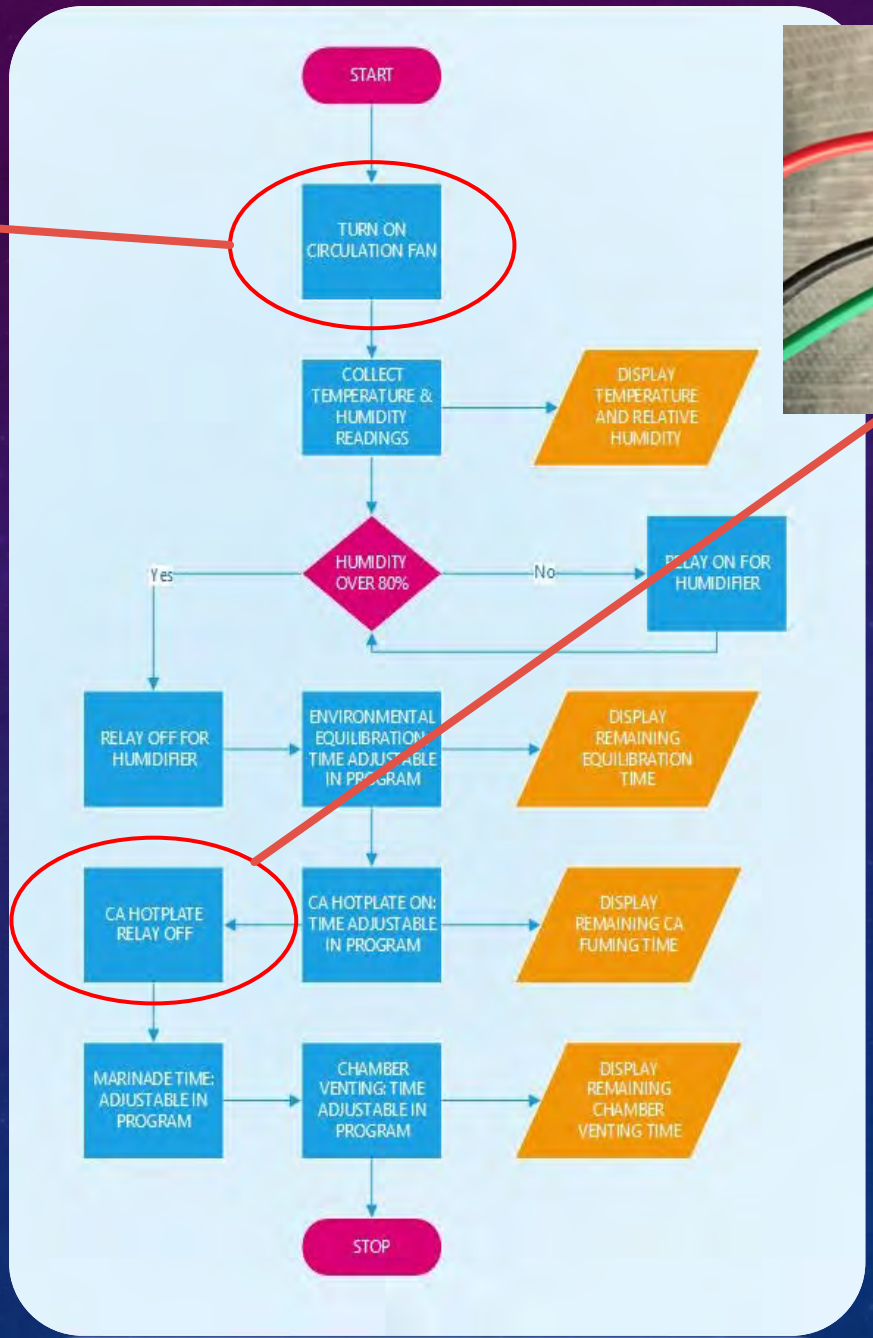

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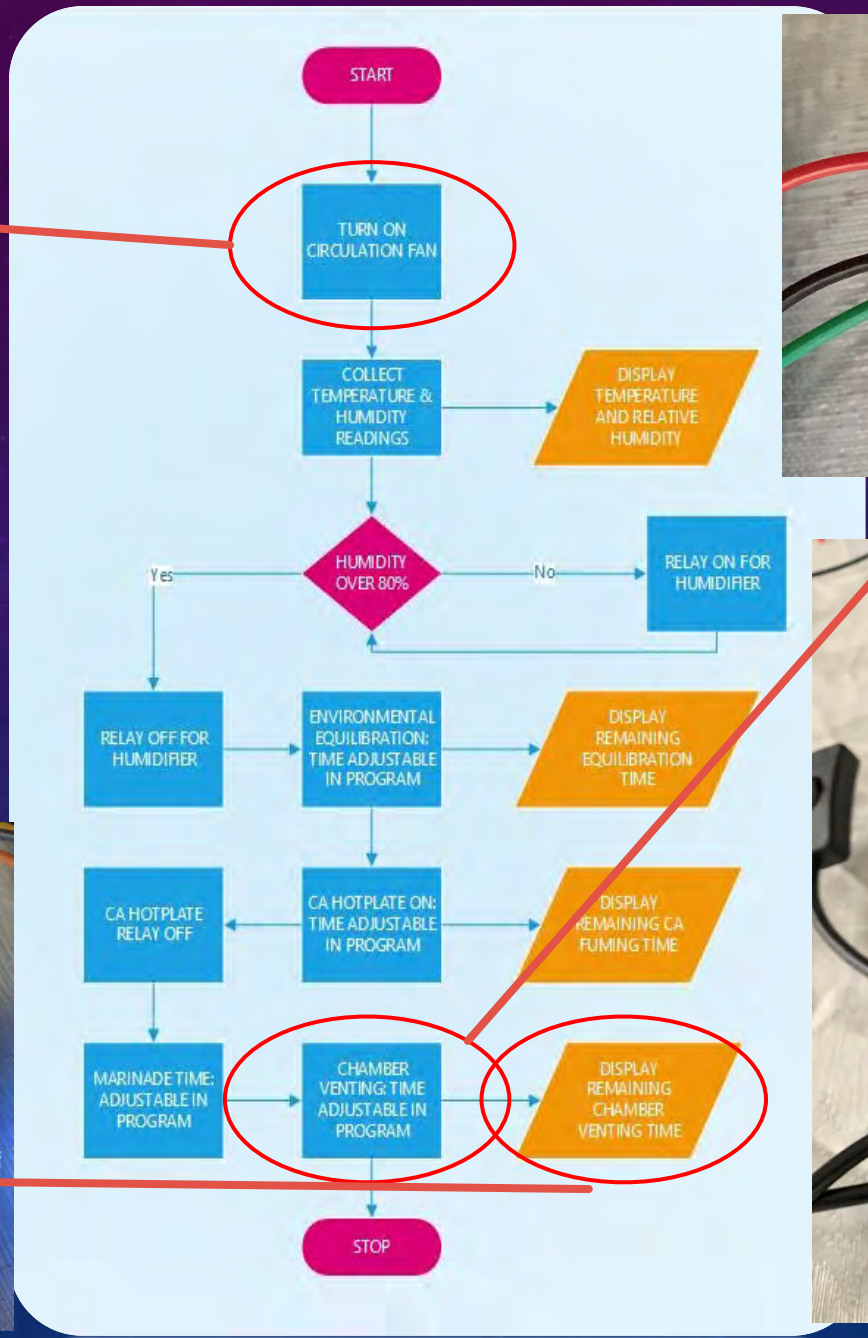

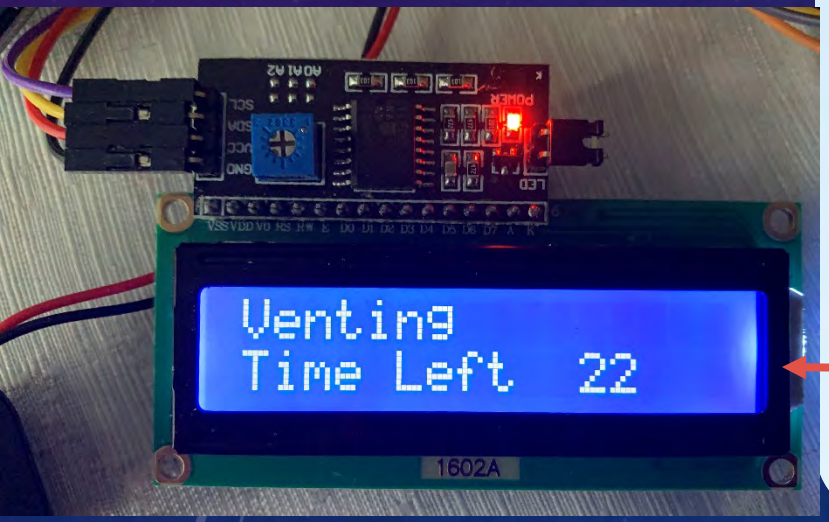

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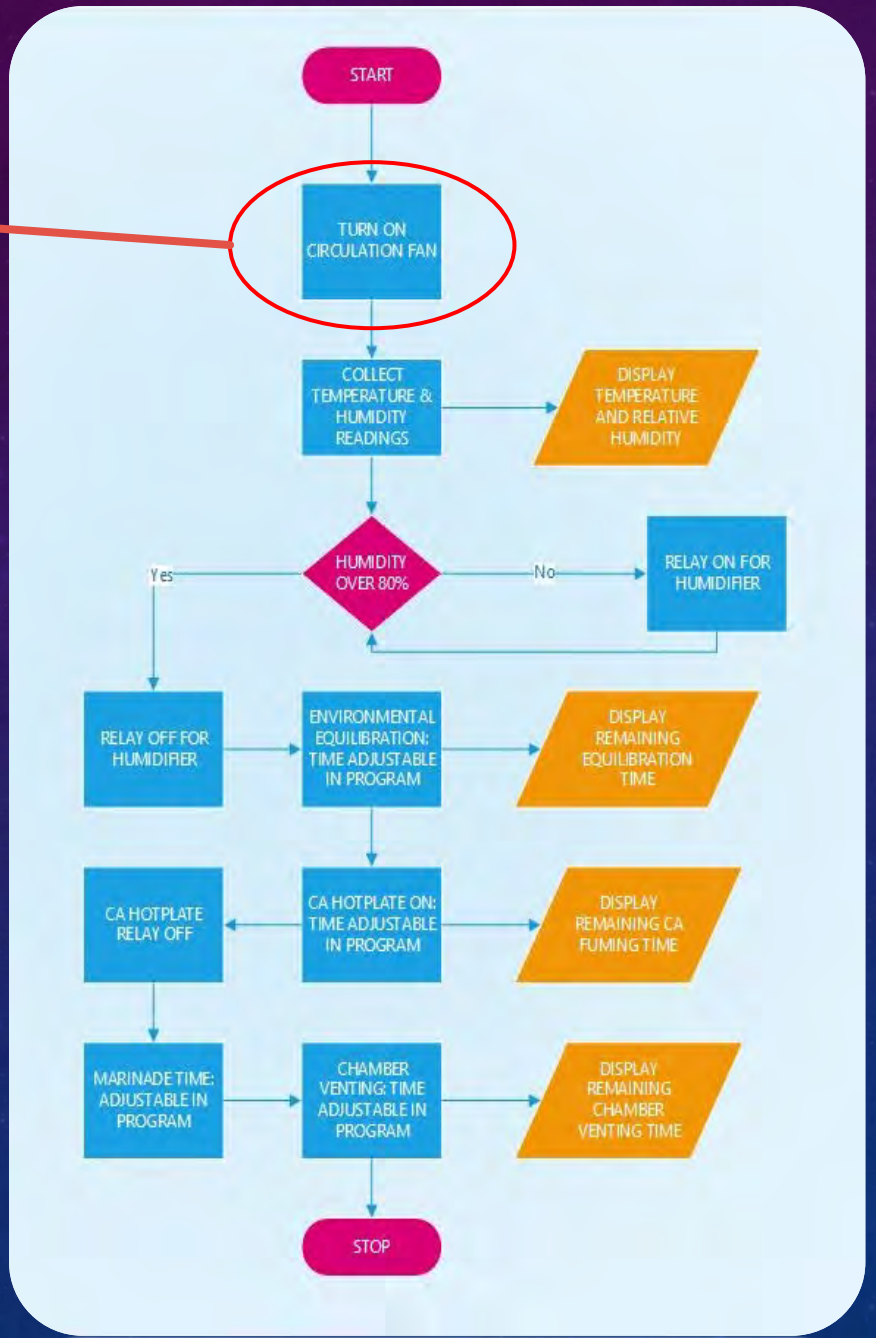
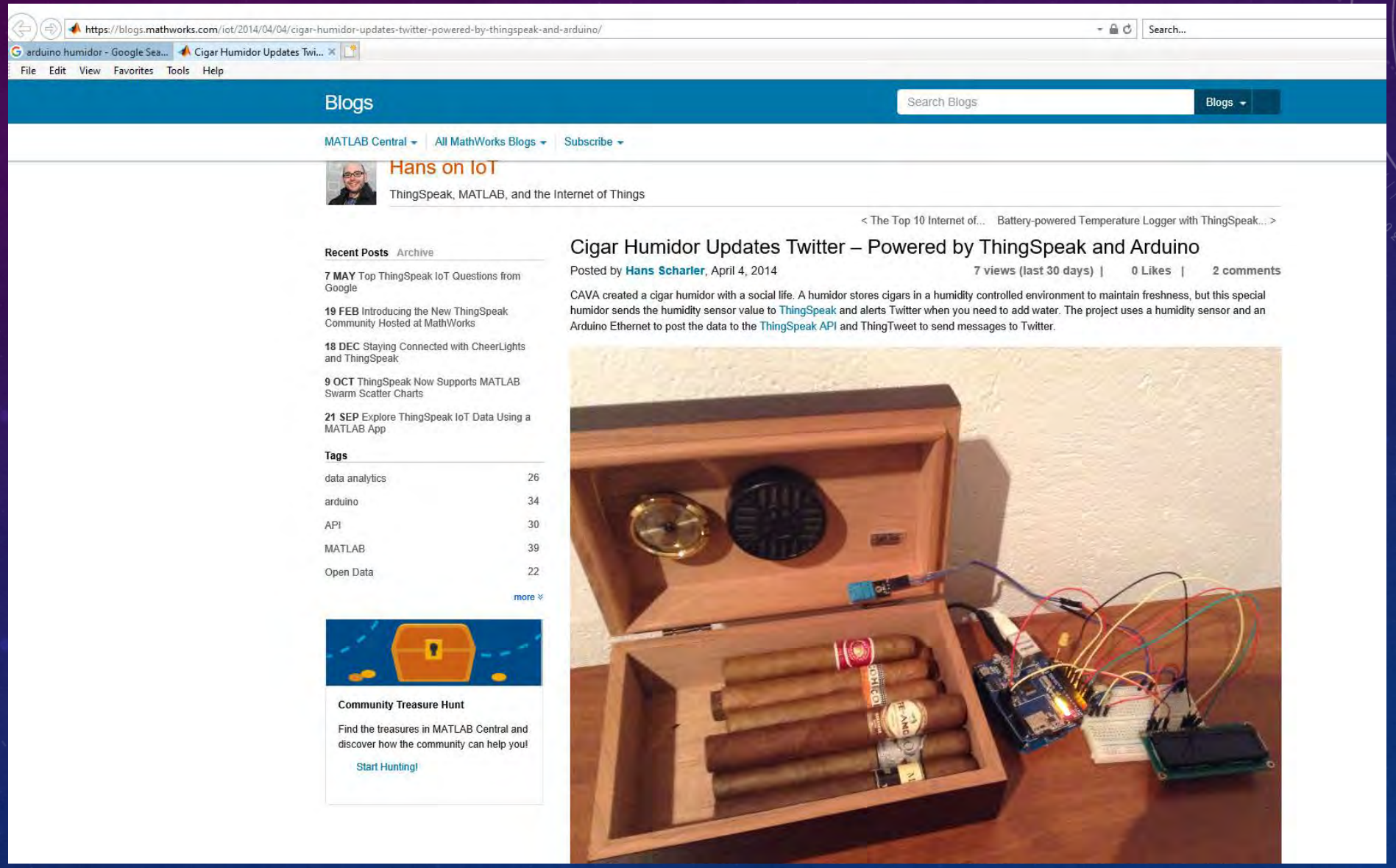


GETTING STARTED

BUILDING A HUMIDOR AS A FIRST (OR SECOND) STEP



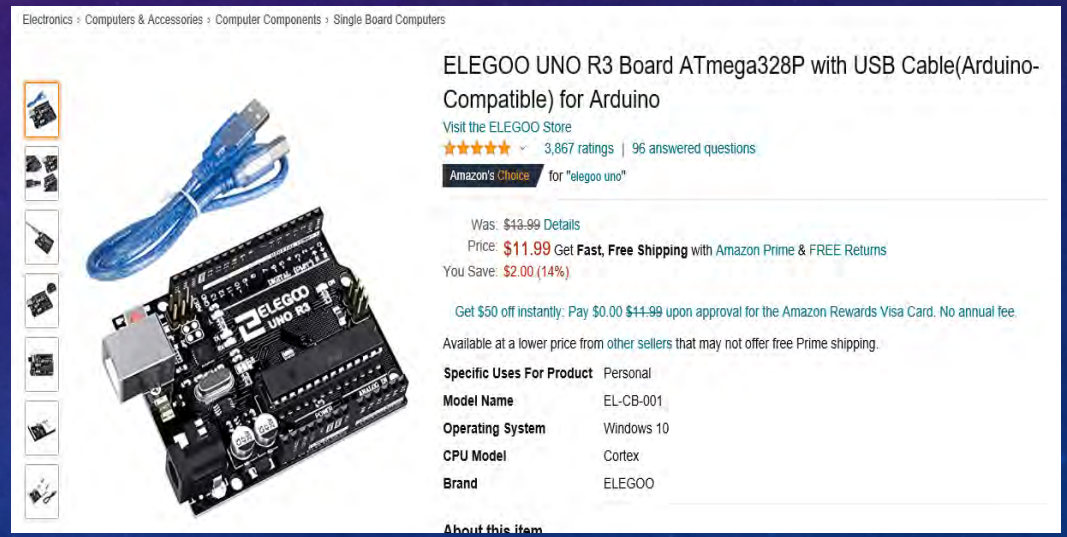
WHAT DOES ALL THIS COST?

Genuine Arduino Uno

$21 (Amazon)

Generic Arduino Uno

$12 (Amazon)



WHAT DOES ALL THIS COST?

Genuine Arduino Nano

$21 (Amazon)

Generic Arduino Nano

< $5 Each (Amazon)

WHAT DOES ALL THIS COST?

DHT 22 Temp and Humidity

$7 (Amazon)

DHT 11 Temp and Humidity

$2 Each in bulk (Amazon)

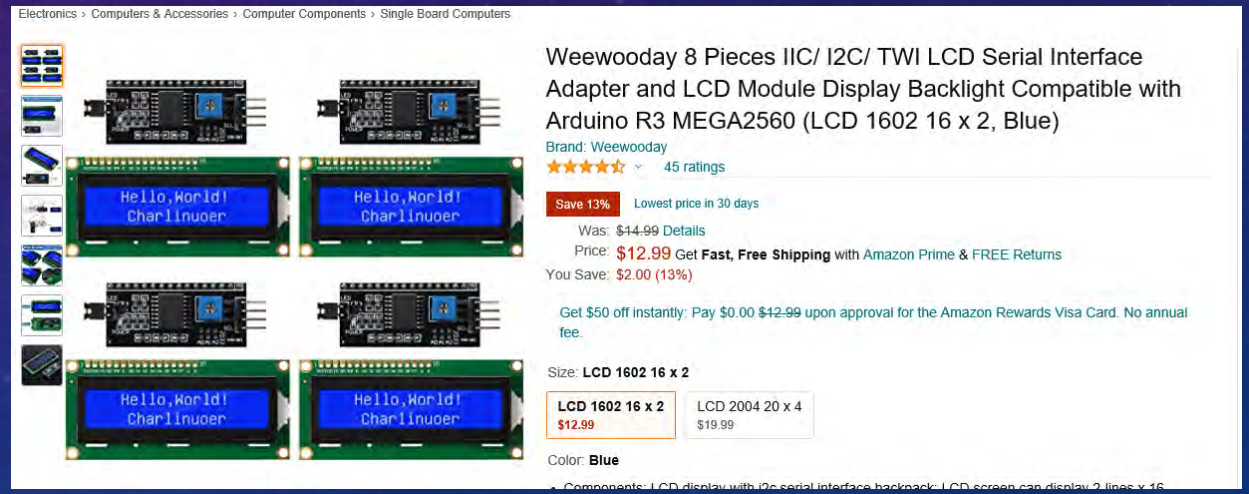
WHAT DOES ALL THIS COST?

1602 Display with I2C

$10 (Amazon)

1602 Display with I2C

$3 Each in bulk (Amazon)



WHAT DOES ALL THIS COST?

Iot Relay

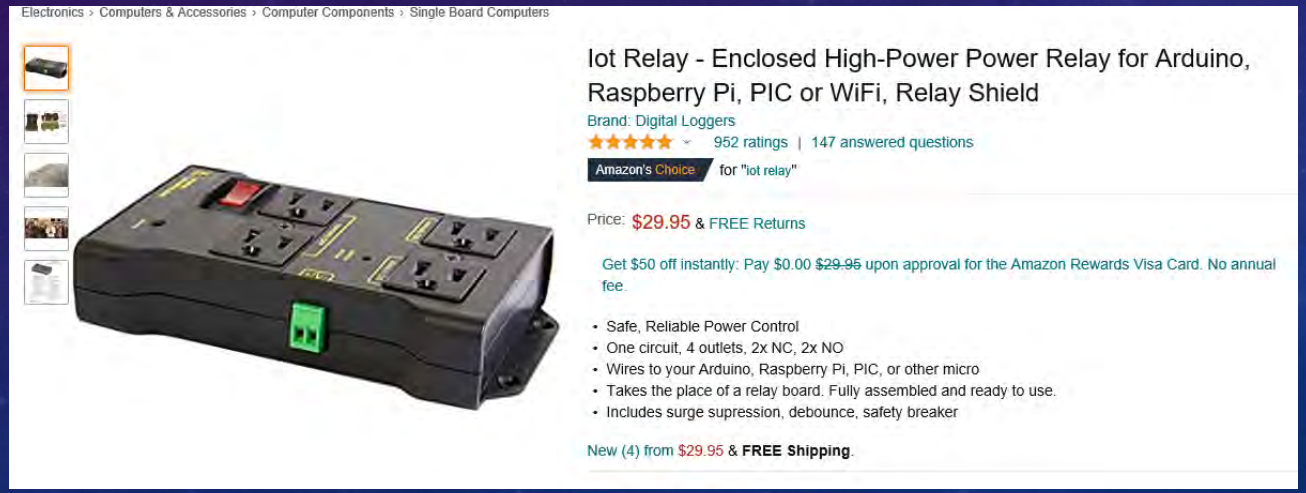
$30 (Amazon)

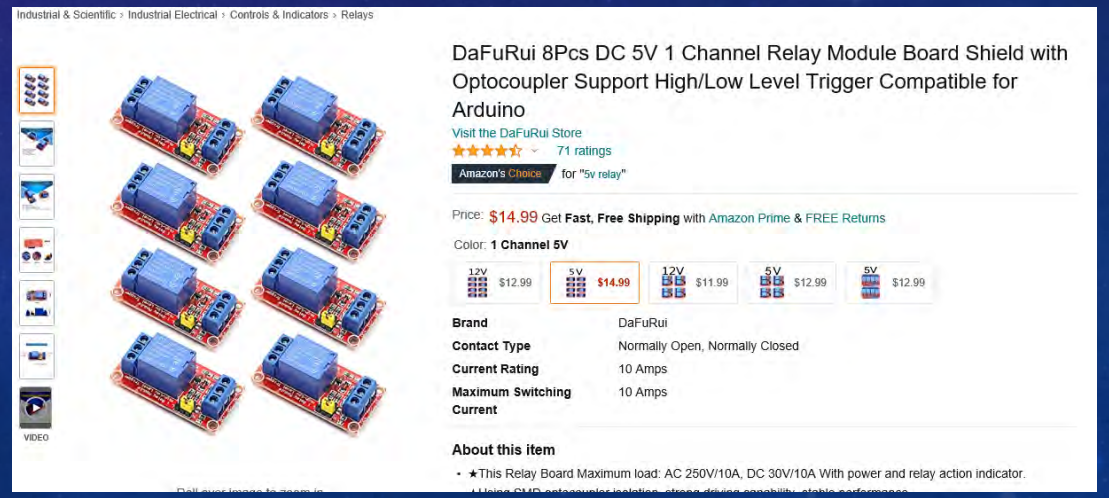
5 V Relay with optocoupler

$2 Each in bulk (Amazon)

Dangerous

*** Use Extreme Caution***





WHAT DOES ALL THIS COST?

High-end Build Cost

Luxury Edition		
Arduino Uno	$	21.00
DHT 22 Temp and Humidity Sensor	$	7.00
1602 Display with I2C	$	10.00
IOT Relay (x 3)	$	90.00
Wires and Miscellaneous	$	20.00
Chamber	$	200.00
Coffee Cup Warmer	$	12.00
Vent with Carbon Filtration	$	150.00
Humidifier	$	20.00
TOTAL	$	530.00

Low-end Build Cost

Poor Man's Version		
Generic Nano	$	5.00
DHT 22 Temp and Humidity Sensor	$	2.00
1602 Display with I2C	$	3.00
Cheap Chinese Relay (x 3)	$	6.00
Wires and Miscellaneous	$	10.00
Broken beverage Refrigerator	$	-
Coffee Cup Warmer	$	12.00
Old Vacuum Cleaner for vent	$	-
Used humidifier	$	10.00
	$	48.00

SO WHY BUY WHEN I CAN DIY?

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DIY UNITS WILL PROBABLY LACK MANY OF THE SAFETY FEATURES ASSOCIATED WITH A COTS UNIT

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- Addition of a data logger to monitor environmental conditions.

OTHER POSSIBLE ARDUINO BUILDS FOR A LAB

Humidity chamber for Ninhydrin (an easier starting build – Think Humidor)

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- Temperature (Refrigeration and ambient)
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- Air quality dust, humidity

Automation of repetitive processes, like dispensing and transferring of liquids

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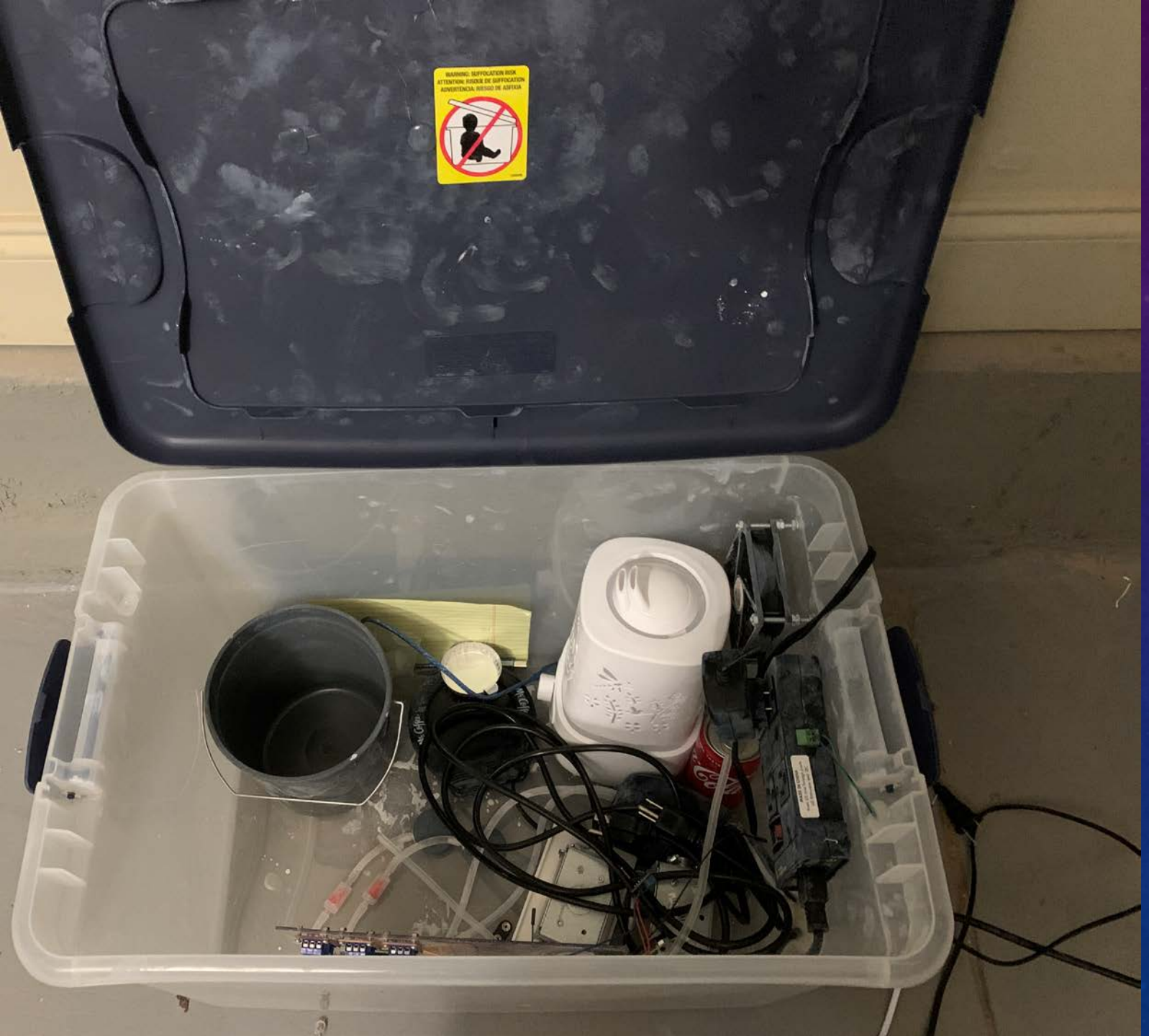
- Have patience. This is like learning any language. At first it seems difficult, but with some practice, you can easily pick up the parts needed to get by.

ALTERNATIVE TO ARDUINO (RASPBERRY PI)

- A full computer, not just a microprocessor
- Fits in the palm of your hand
- Runs on Python, not C/C++
- Built in ports (USB 2.0,3.0; Wi-Fi, Bluetooth, micro-HDMI)
- More expensive
- Better for more complex projects

- Image source: amazon.com



THE WORKING PROTOTYPE

- Clay Allred
- Bureau of Alcohol, Tobacco, Firearms, and Explosives (ATF)
- Forensic Science Laboratory – Atlanta