Project title: Weather-Tek 1

Start date: January 8-2021

End date : April 6-2021

Company name : BONZ LTD

Team contact information

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Meeting with client

Clients statement

“I leave my office and I always forget to check the weather outside. If it is windy outside I would like to remember to wear my wind breaker. I would like a weather station – an eco-friendly one!”

Clients contact information: DavisJ80@macewan.ca

Meeting:

Do you have any specific measurement for the weather station?

“I would like it to be portable.”

How long would you like for the weather station to be ready for use?

“Two to three months is a good time frame for me”

How would you like to receive information outputted by the weatherstation?

“I think it would be nice to have a display on the weather station so I can see it when I pass by.”

Problem Statement

The goal is to design a weather station which can measure and display the information needed about the weather to the client. It must be eco-friendly and safe to use.

Constraints

Our constraints concerning this project include budget, time, and workload. As students, we do not have access to as much money as we wish for. Which is why we will produce a design within a budget that will still meet the needs of the client. Given that group members have coursework to complete, this will hinder us from meeting every day to work on the project.

With the COVID restriction, meeting in person will not be consistent as we would like. This will cause a disconnect with the members as working together in person allows for team building and a more efficient workspace.

The constraints with the project itself, it must be eco-friendly. This would mean we have to find a power source that meets this requirement. It would also have to be made with minimal material and not produce any waste.

Parts

Measure Humidity (L: 1.5 x W: 0.7 x H: 2.5)cm

- DHT11 Digital Temperature Humidity Sensor Module for Arduino
    - Humidity measurement range: 20%~90%RH
    - Humidity measurement error: ±5%RH
    - Temperature measurement range: 0~60
    - Temperature measurement error: ±2
    - Working voltage :5 V Size: 28x12x8mm

Temperature sensor (L: 2.0 x W: 1.2 x H: ")cm

- (TMP36)
    - Communication protocol: analog output ``
    - Power Supply range: 2.7V to 5.5V
    - Temperature Range: -40˚C to 125˚C
    - Accuracy: +/-1˚C (at 25˚C)
    - Interface with Arduino: analogRead()
        - https://randomnerdtutorials.com/9-arduino-compatible-temperature-sensors-for-your-electronics-projects/

Rotary encoder (Dia: 2.2 x H: 3.2) cm

- RES20D-50-201-1
    - Voltage supply: 5V
    - Built-in switch:No
    - Mounting type: Panel Mount
    - Actuator type: Shaft
    - Terminator style: Wire leads
        - https://www.digikey.com/en/products/detail/nidec-copal-electronics/RES20D-50-201-1/6469509

LCD Screen (L: 7.0 x W: 3.5 x H: 1.0) cm

- 240×320, General 2inch IPS LCD Display Module
    - Driver: ST7789
    - Interface: SPI
    - Display color: RGB, 262K color
    - Resolution: 240×320
    - Backlight: LED
    - Operating voltage: 3.3V

- https://www.buyapi.ca/product/240-320-general-2inch-ips-lcd-display-module/

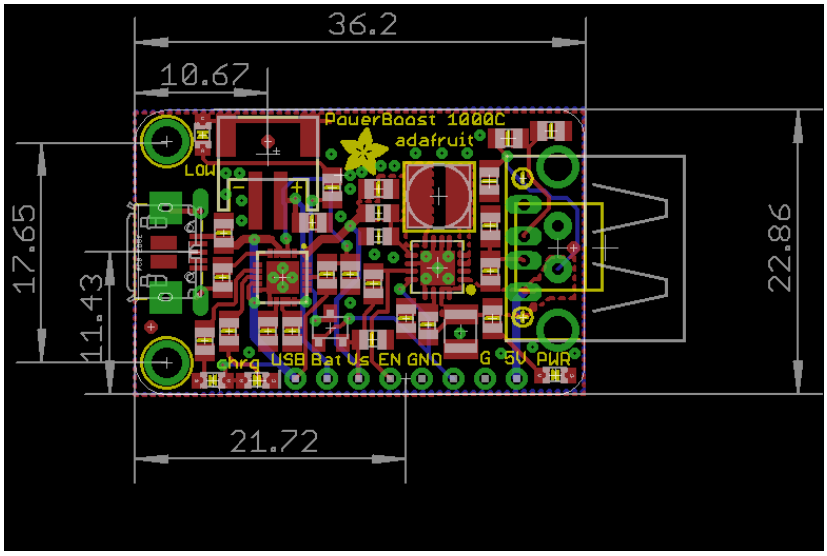
Arduino board

Arduino dimensions 6.86 x 5.34 cm

- Arduino Uno Rev 3
  - OPerating voltage: 5V
  - Maximum Output Current: 150mA
  - Maximum Voltage Dropout: 350mV @ 150mA
  - Typical Quiescent Current: 1.5mA
  - Power Consumption: @ 9V
    - https://diyi0t.com/arduino-uno-tutorial/

PowerBoost 1000c

dimensions



- Operating Voltage 5V
- **Micro USB** - this is the micro USB 5V power pin. It's the pin that is used to charge the batter
- **BAT** - this is the battery input, connected directly to the JST connector. For most Lithium batteries, this will range from 3.0V when near-dead to 4.2V when fully charged
- **VS** - this is the load shared output from the battery charger. When there is 5V coming in from the micro-B USB power plug, this pin will have approx 5V on it (less a little due to the internal resistance of the charger chip's MOSFET). When there's no USB charging, the Vs pin will be the same voltage as the Bat pin
- **GND** - This is the power ground. This boost converter is not 'isolated' - the ground input is the same as the ground output

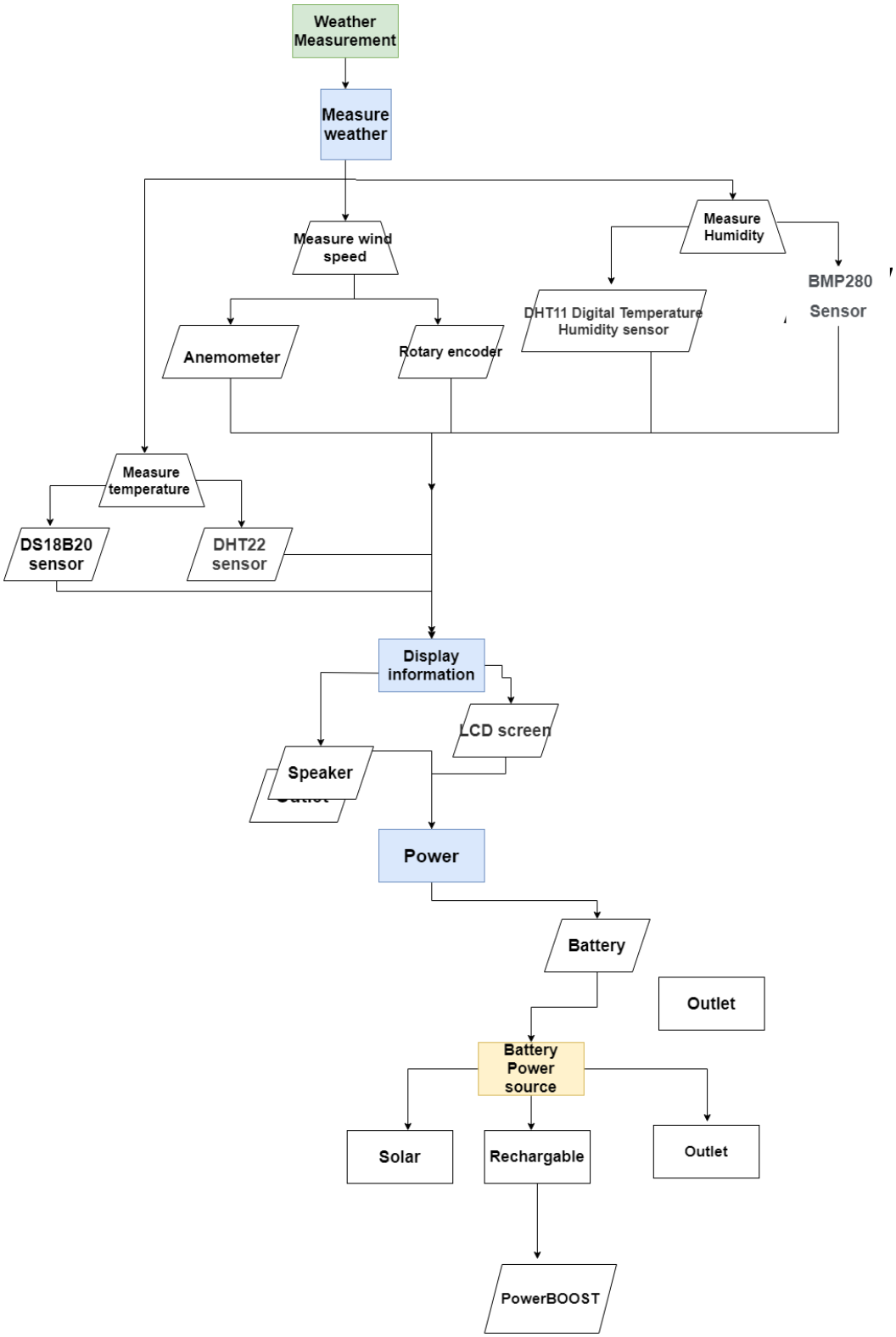
- **5V** - this is the boosted output. When the board is running, the voltage will be 5.2V approximately. It may dip down to 5V as the current draw starts to go up (over 500mA). There's a blue LED connected to this pin which will let you know when there's the power output

Brainstorming

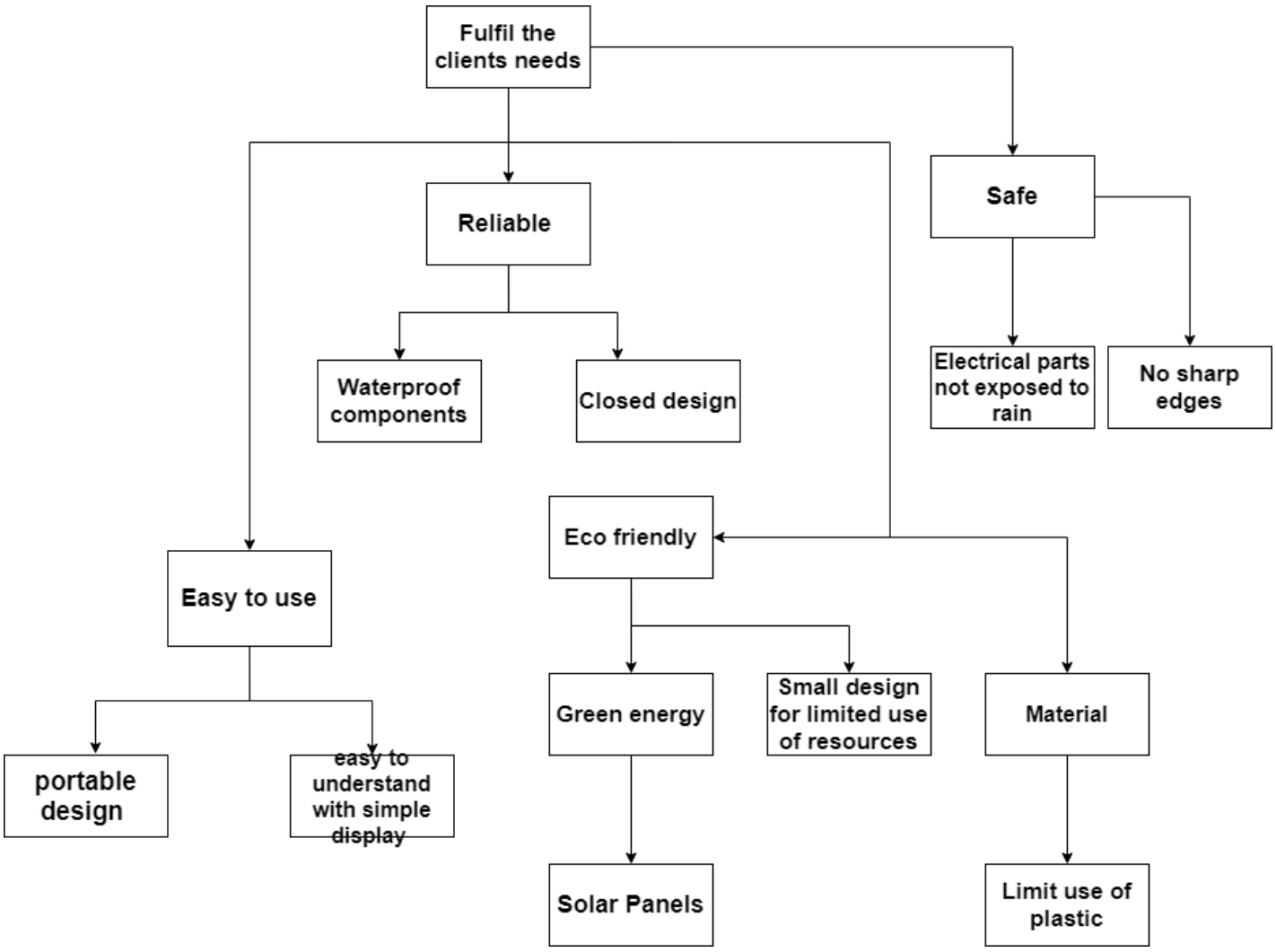
Weather station:

- Measure wind speed
-Rotary encoder
-Process information
-Arduino
-Power
-Battery
-Solar Panel
-Outlet
-Raspberry Pi

Functions trees

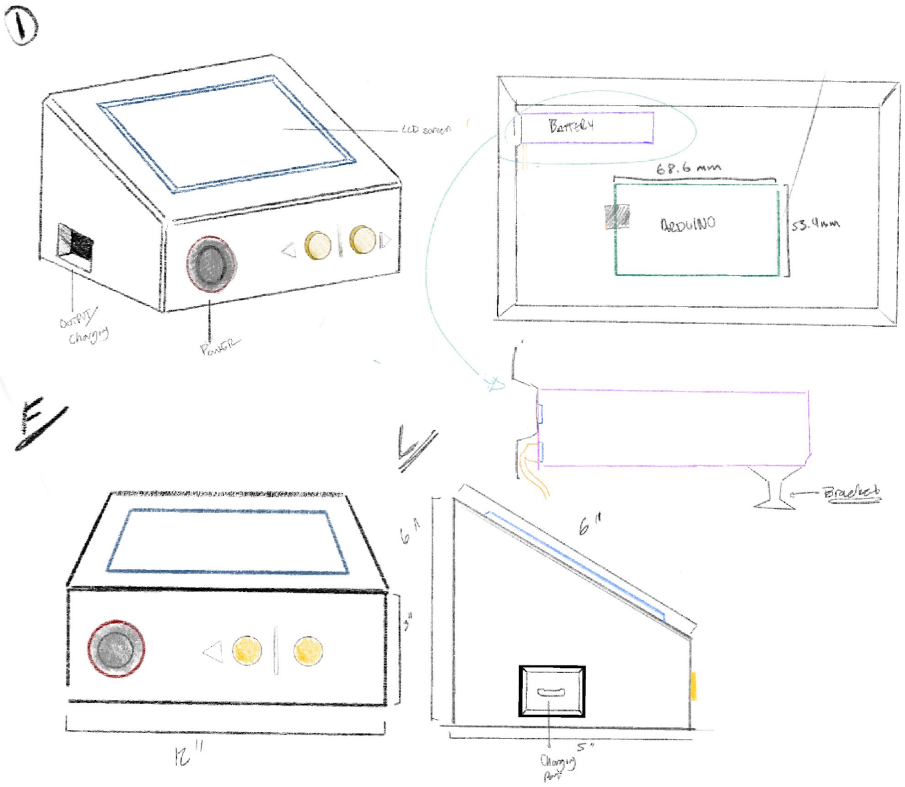


Objective Trees

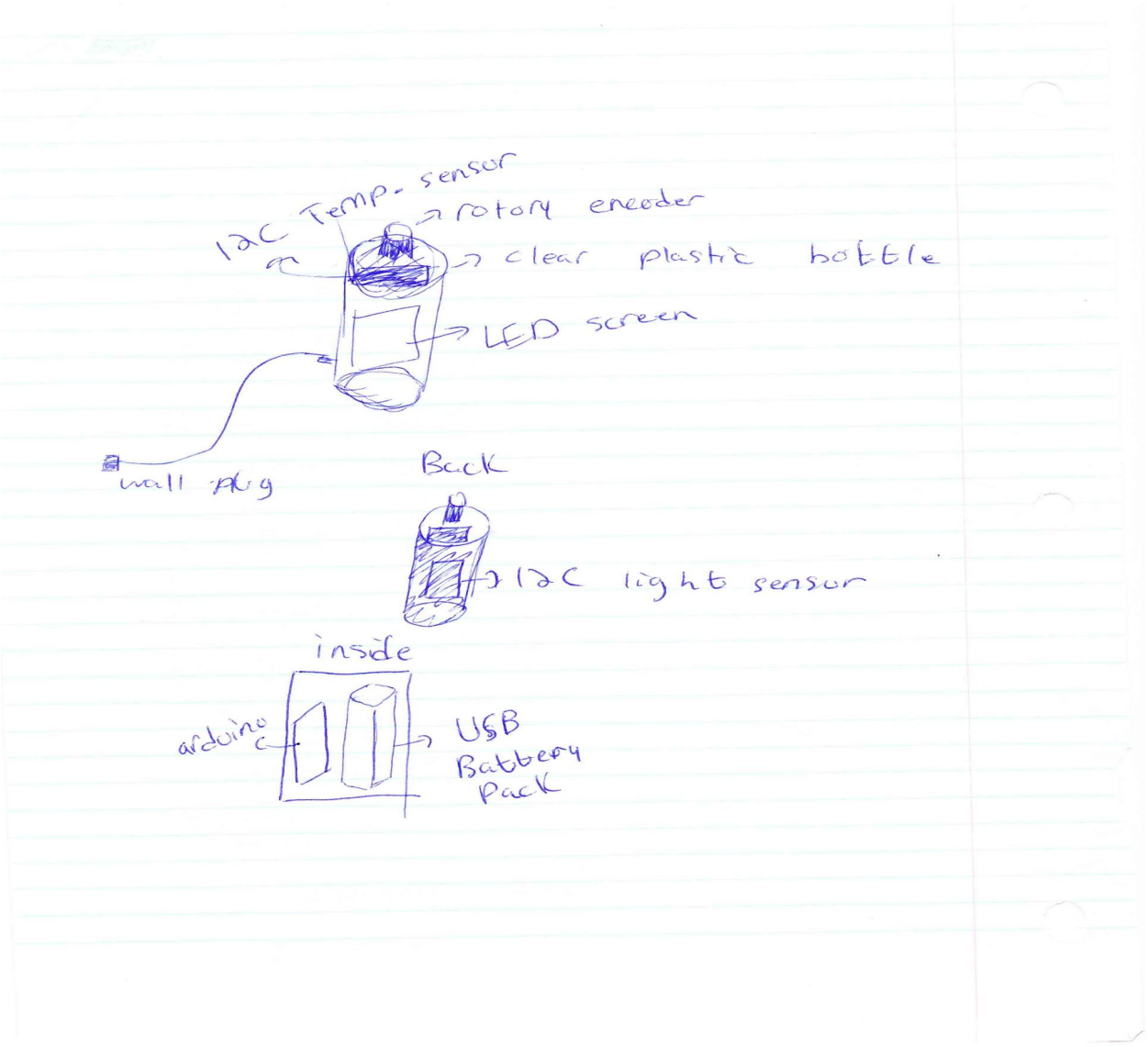


Sketches

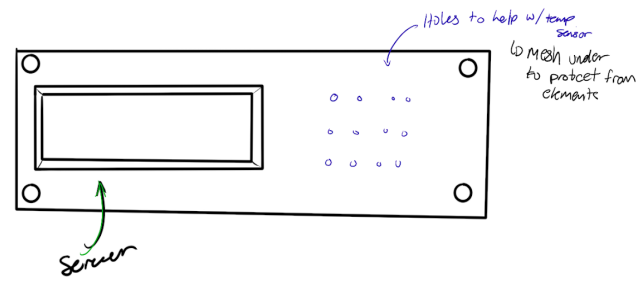
Design 1

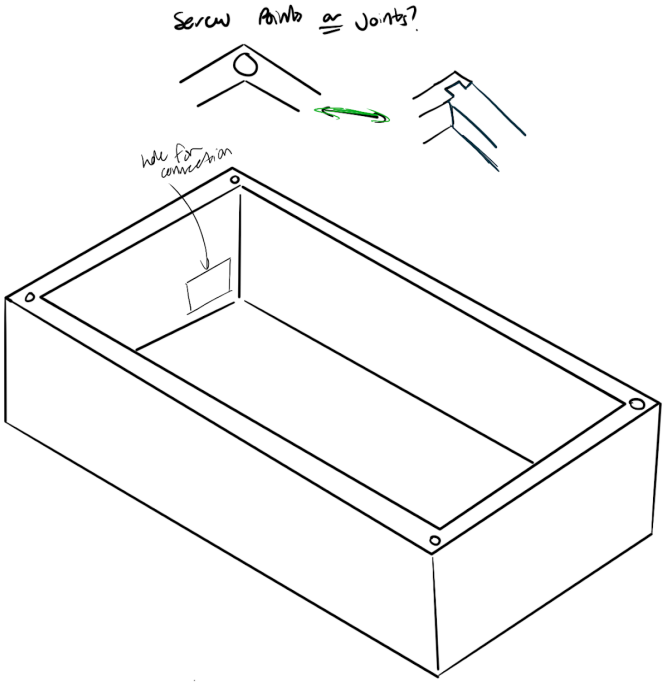


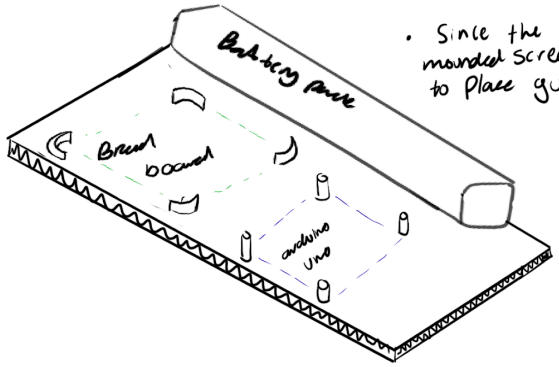
Design 2


I2C
Temp. sensor
rotary encoder
clear plastic bottle
LED screen
wall plug
Back
I2C light sensor
inside
arduino
USB
Battery
Pack

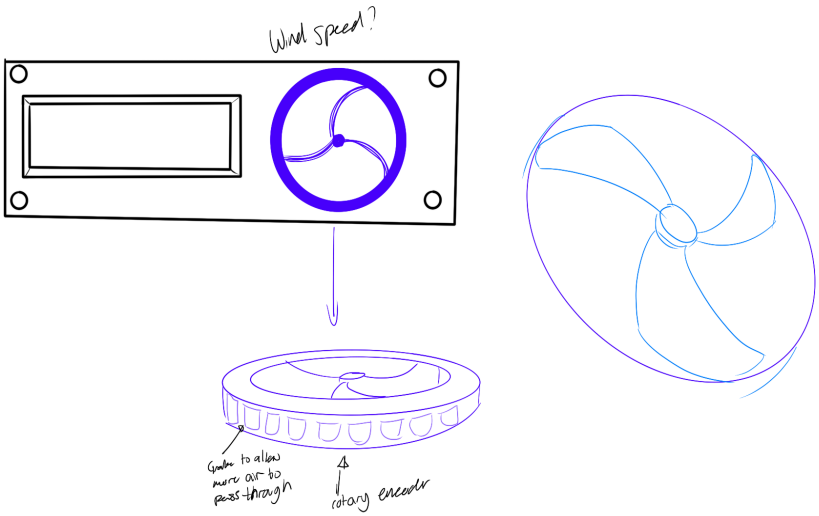
Design 3



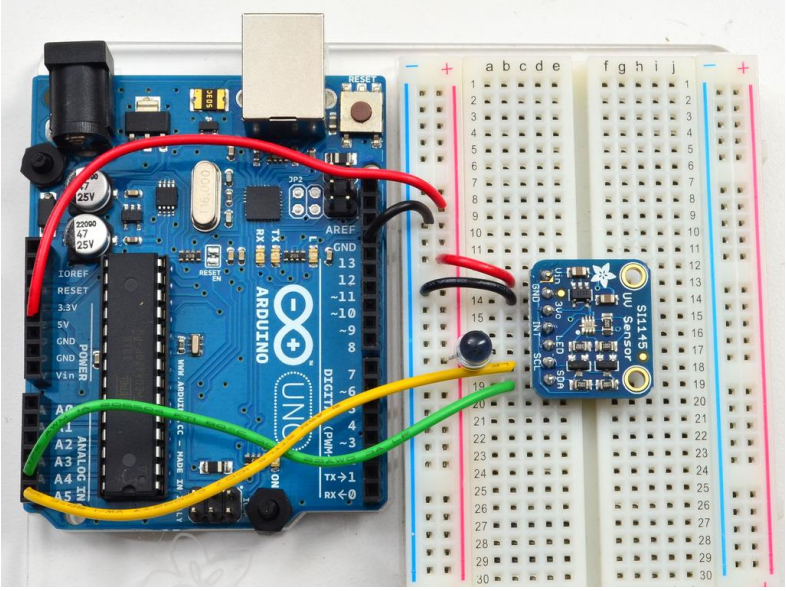




- Since the bread board has no mounted screw on it, we are going to place guard on every corner

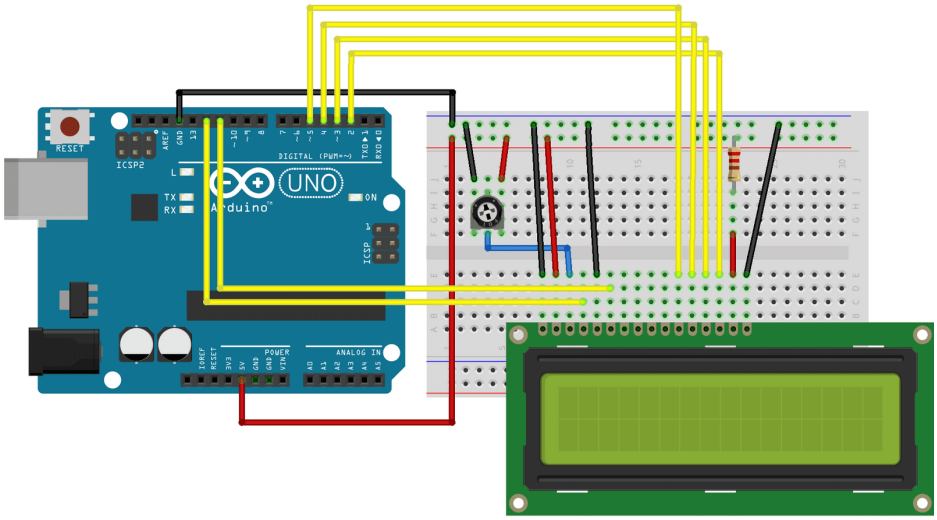

Wind speed?
Grates to allow more air to pass through
rotary encoder

Drawings/Schematics



Taken from:
https://learn.adafruit.com/adafruit-mcp9808-precision-i2c-temperature-sensor-guide/arduino-code
Arduino Temperature Sensor
SCL ----------> SCL (clock)
SDA <---------- SDA (data)

- Connect Vdd to the power supply, 3V or 5V is fine. Use the same voltage that the microcontroller logic is based off of. For most Arduinos, that is 5V
- Connect GND to common power/data ground
- Connect the SCL pin to the I2C clock SCL pin on your Arduino. On an UNO & '328 based Arduino, this is also known as A5, on a Mega it is also known as digital 21 and on a Leonardo/Micro, digital 3
- Connect the SDA pin to the I2C data SDA pin on your Arduino. On an UNO & '328 based Arduino, this is also known as A4, on a Mega it is also known as digital 20 and on a Leonardo/Micro, digital 2



Taken from: https://www.arduino.cc/en/Tutorial/LibraryExamples/HelloWorld

To wire your LCD screen to your board, connect the following pins:

- LCD RS pin to digital pin 12
- -LCD Enable pin to digital pin 11
- -LCD D4 pin to digital pin 5
- -LCD D5 pin to digital pin 4
- - LCD D6 pin to digital pin 3
- -LCD D7 pin to digital pin 2
- -LCD R/W pin to GND
- -LCD VSS pin to GND
- -LCD VCC pin to 5V
- -LCD LED+ to 5V through a 220 ohm resistor
- -LCD LED- to GND

Research

“Arduino Weather Station Project - Overview,” *Design - Make - Code - Deploy*. [Online]. Available: http://cactus.io/projects/weather/arduino-weather-station. [Accessed: 20-Jan-2021].
- This is a weather station project that uses an Arduino board with an Ethernet for communication. The station measures both external and internal temperature as well as humidity, pressure, wind speed and wind direction.

“Arduino Wireless Weather Station Project,” *HowToMechatronics*, 05-Feb-2021. [Online]. Available: https://howtomechatronics.com/tutorials/arduino/arduino-wireless-weather-station-project/. [Accessed: 20-Jan-2021].

- This weather station has wireless communication between the indoor and outdoor parts using transceiver modules. Having two parts creates the need for two Arduino controllers. The indoor part includes a OLED screen to display information. The indoor part is powered by a 9V-12V power jack while the outdoor part is powered by two 3.7V batteries. The outdoor part only has one sensor module which is a DHT22 sensor. This sensor measures both temperature and humidity.

Opengreenenergy and Instructables, “SOLAR POWERED ARDUINO WEATHER STATION,” *Instructables*, 02-Jun-2019. [Online]. Available: https://www.instructables.com/SOLAR-POWERED-ARDUINO-WEATHER-STATION/. [Accessed: 20-Jan-2021].

This project uses a DHT11 sensor which measures temperature, humidity, rainfall and pressure. It uses a transmitter receiver pair to send and receive information. It is powered by solar panels that charge 2 AA batteries. To power the arduino the voltage required is 5V which means a boost converter is required for this project.

“Weather Robot,” *Arduino Project Hub*. [Online]. Available: https://create.arduino.cc/projecthub/4244/weather-robot-c5a2f2?ref=tag&ref_id=weather&offset=62 . [Accessed: 20-Jan-2021].

This project has an interesting design that looks like a gamebot. It’s powered by Arduino UNO. The DHT22 sensor is used for temperature and the BMP085 sensor is used to measure pressure. It displays the output on a ks0108 LCD screen.

https://create.arduino.cc/projecthub/projects/tags/weather

Selection

Design 1

Pros:

- Simple shape .
- Has distinct buttons.
- Angled screen allows for a better viewing angle.
- Rechargeable battery for wireless use

Cons:

- Size maybe be large to be portable
- No clear way of designing the windmill into the design at the time.
- Choosing a bigger screen would require power power consumption.

Design 2

- Too small
- Round shape cannot allow for lcd screen to cooperate

Design 3

Pros:

- In terms of shape, it is not an overly complicated shape, and portabel.
- Less time to print, which means we do not have to 3D print the shape as solid and it still looks solid.
- Compared to Design 1 and 2, Design 3 has the most benefit in terms of layout for the electronics board such as Arduino and Breadboard.

Cons:

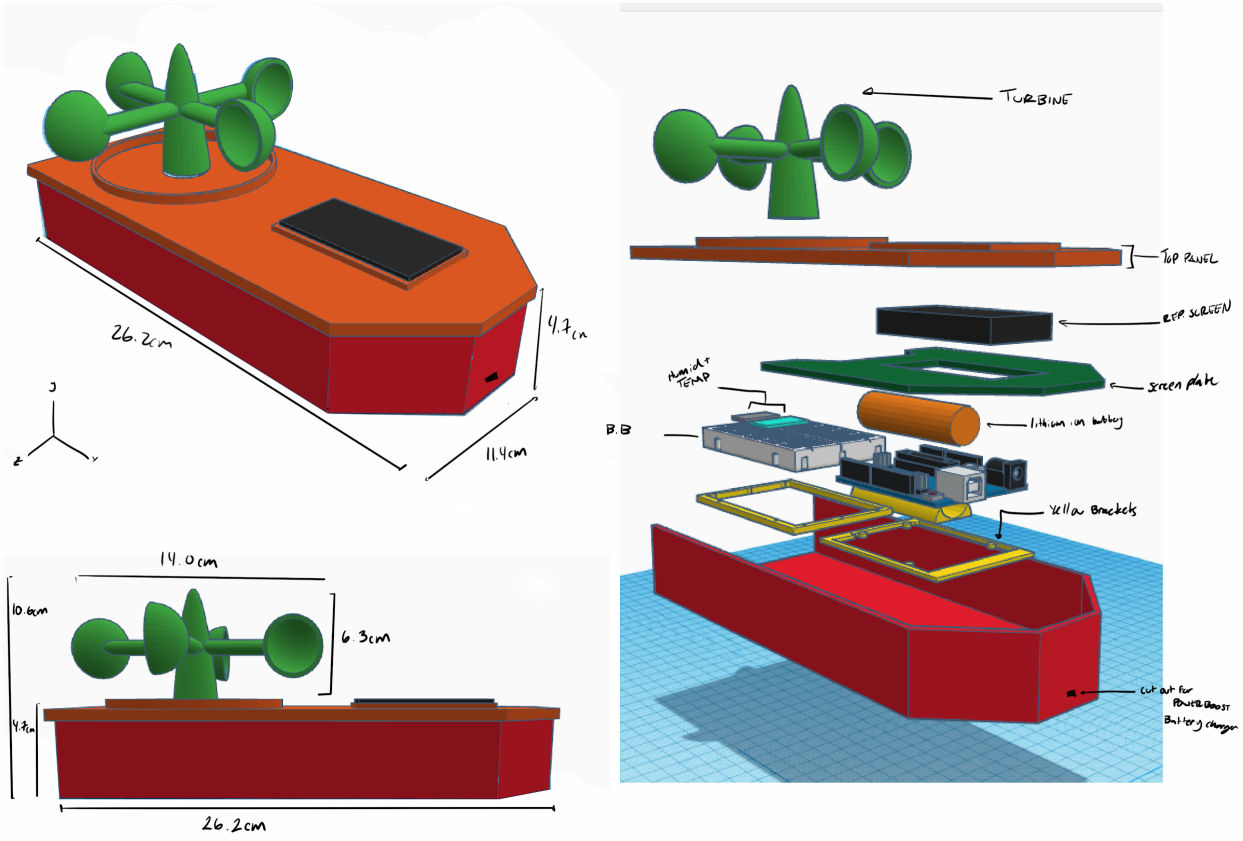
- No aesthetic
- In term of size, it is quite big
- For the windmill position, it sticks out of the shape and is covered by the cover of the windmill case which means it may not accurately capture wind speed.

Design 4

- Slight variation of design 3. Only difference is that the shroud that goes over the turbine is eliminated completely to provide better wind efficiency.
- The turbine is 5 cm bigger in all dimensions .

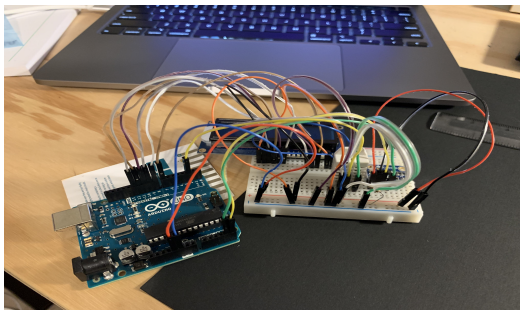
Statement

The design that was chosen among the three was design 4. Design 4 had the most versatility within our time and budget. Although the design of the windmill is not conventional, we are certain that we can make it perform equally as a normal windmill. The temperature sensor will be located underneath which is exposed to the air with pinholes, allowing some of the environment to be sensed by the sensors. This will allow for more accurate measurements as the components are enclosed in a tight space.Brackets *in yellow) were made to minimize the use of glueing and screwing. This allows us to keep components in place rather than move freely inside the design. The screen plate is put in order to su[[prt the screen in place while still allowing for wiring to go through. There is a 16mm button located on the other side. This functions as the main on/off switch and the screen will cycle through the information until it is pressed again to turn off.

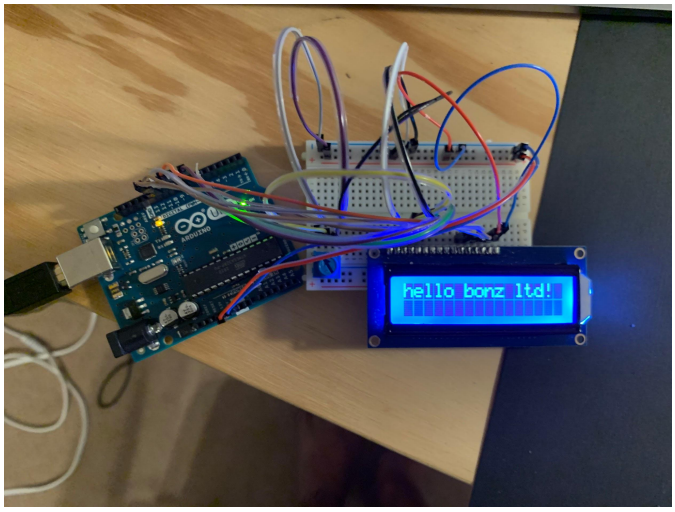


Progress

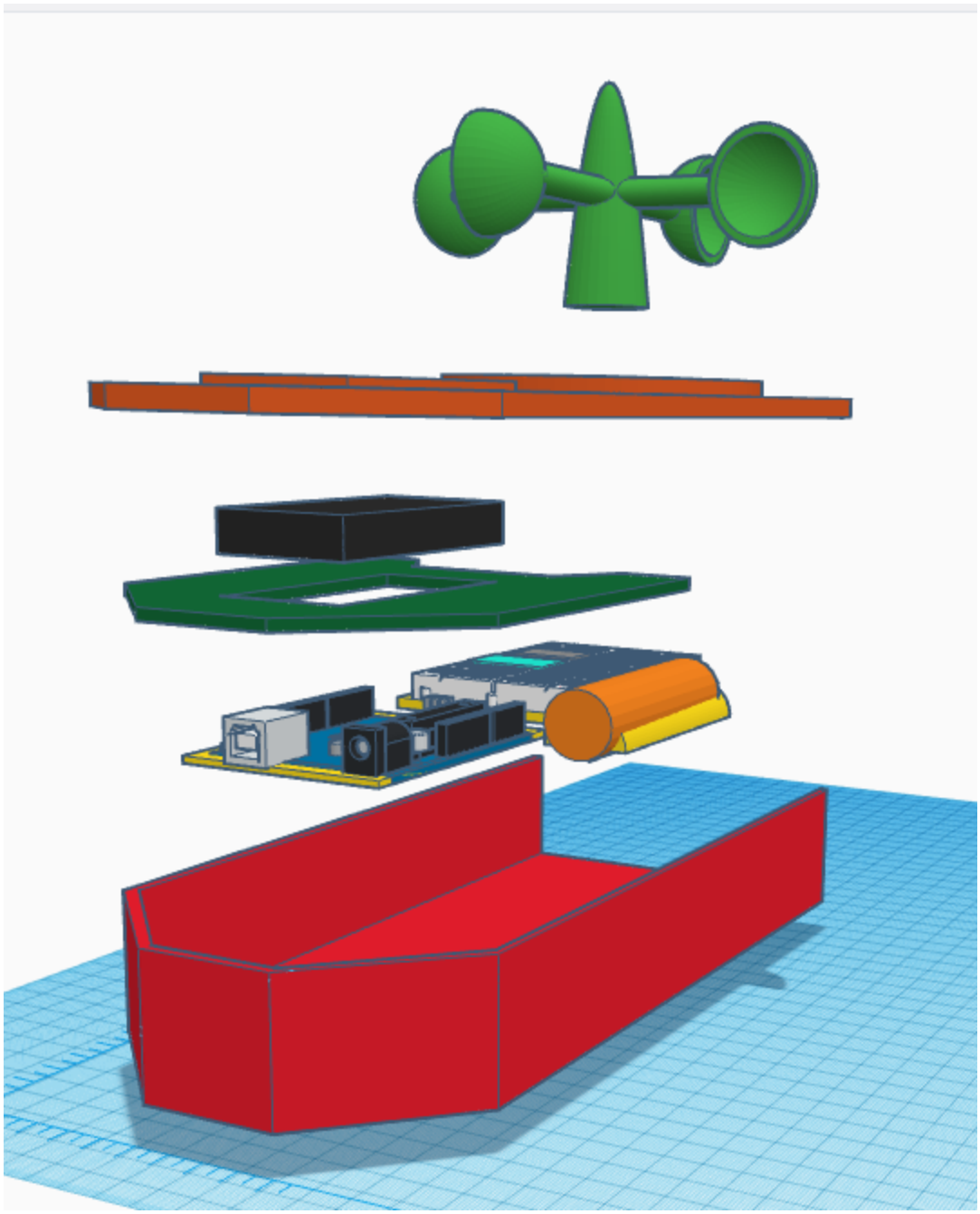
We tested the temperature sensor ,MCP9808, and it shows clear indication that the Arduino board and temperature sensor works, and accurately measured the current temperature, and since we tested inside the house it clearly shows that it is showing room temperature in Celsius and Fahrenheit. For the final project, we decided to only show the temperature in Celcius.



We also tested the LCD Screen, and showed indication that it works. Since this the our first time experimenting with arduino software and breadboards, we have run into some troubles trying to display the information from our sensors onto the LCD screen. For example, the temperature sensor works as it should but we are still figuring out how to display the information we want to display onto the screen.



We also experienced troubleshooting problems as the breadboard might have been too small to fit everything we wanted onto it. This was found when the LCD screen took up the most pins out of the board. We are looking into ways to fix this and make the screen separate from the board and connect it using wires rather than the pins themselves



We finally have the 3D model ready to 3D print. The program used to model the design was TinkerCAD. A free browser program. We test different programs such as Blender but it proved to be advanced for students who have not experienced 3D modeling. AutoCAD required us to pay for a subscription, which did not suit our preference. TinkerCAD was beginner friendly and gave premade shapes such as the Arduino and breadboard to accurately scale our model.

Testing

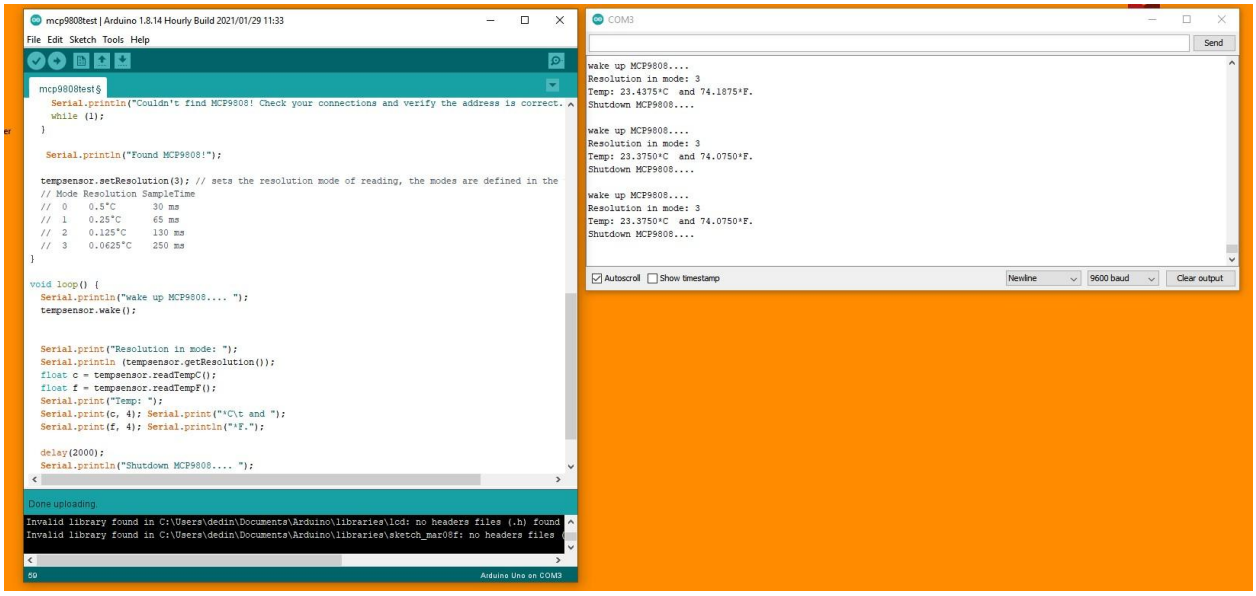
- MCP9808
  For the picture below is the testing of MCP9808 I2C Precision Temperature sensor guide, this is the digital temperature sensor with typical accuracy of ±0.25°C celsius, precision of +0.0625°C, and the sensor range between -40°C to +125°C. There are 3 address pins so you can connect up to 8 to a single I2C bus without address collisions.

  *what it says on the right side of the screen

  Wake up MCP9808….
  Resolution in mode: 3
  Temp: 23.4375*C and 74.1875*F.
  Shutdown MCP9808…

  Wake up MCP9808….
  Resolution in mode: 3
  Temp: 23.3750*C and 74.0750*F.
  Shutdown MCP9808…

  Wake up MCP9808….
  Resolution in mode: 3
  Temp: 23.3750*C and 74.0750*F.
  Shutdown MCP9808…

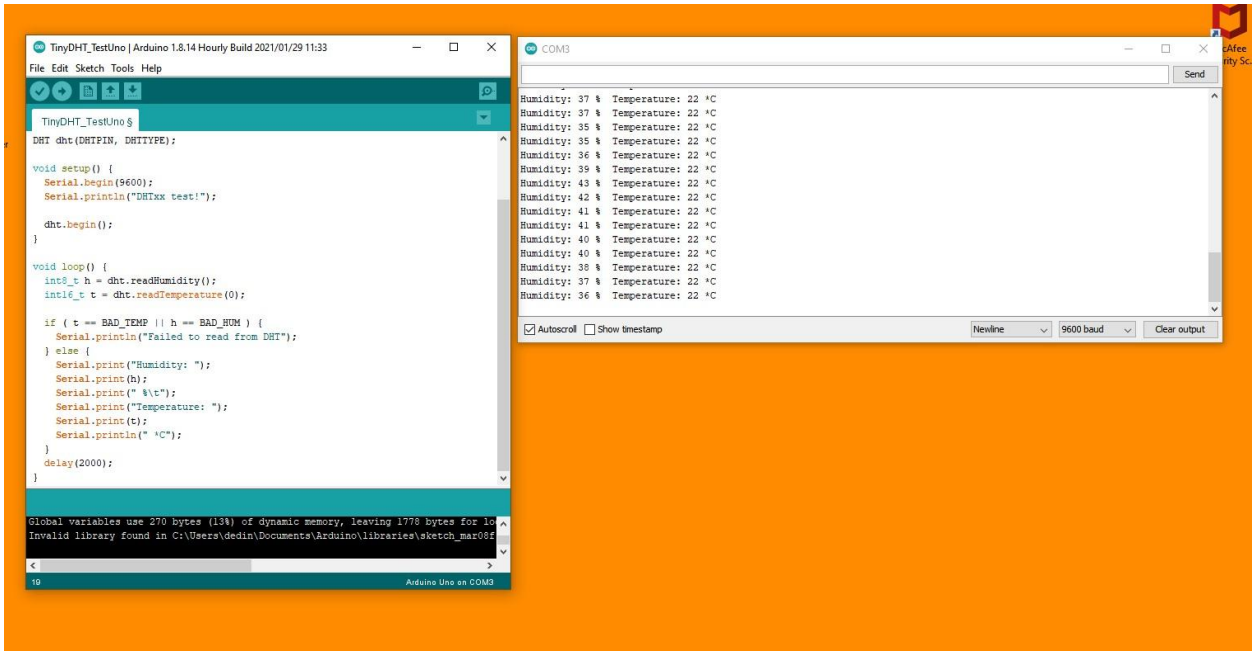


- DHT22

  DHT22 sensor is a low cost humidity and temperature sensor Good for 0-100% humidity readings with 2-5% accuracy, also Good for -40 to 80°C temperature readings ±0.5°C accuracy, with 4 pins with 0.1" spacing.

  *what it says on the right side of the screen

  Humidity: 37% Temperature: 22 *C
  Humidity: 37% Temperature: 22 *C
  Humidity: 37% Temperature: 22 *C



Even though the temperature and humidity sensors only shows 22*C and 37% humidity, we did little testing with the sensor by putting a damped cold towel near the sensor and the temperature drop from the room temperature to the damped cold towel temperature.

- I2C LCD
  The hardest part about connecting the LCD is how to wire it, there's so many pin that we have to connect since we never dealt with this type of project before we have to overcome so many little parts about the LCD including how to code with arduino, and make sure that the Pins connections to the code are match