

ADVANCED SCIENCE RESEARCH CENTER

THE GRADUATE CENTER

CITY UNIVERSITY OF NEW YORK



Citizen Sensor Program

Part of the NextGeneration Sensor Lab
ASRC Environmental Science Initiative



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Citizen Sensor Program

Summary

The ASRC Citizen Sensor Program seeks to design, build and dispatch environmental monitoring sensors with and for local communities.

We believe that putting data collecting power in the hands communities most affect by environmental injustice will help them advocate for greater change.

Please share these resources and contact us if you would like to collaborate!

DIY CO₂ Sensor

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Description

The DIY (Do It Yourself) CO₂ (Carbon Dioxide) Sensor is a low-cost module that can monitor CO₂ levels in the local environment.

Materials

Shields and Sensors



Picture	Name	Specification	Description
	Arduino Uno	Uno Only. Our code does not work with Arduino Leonardo	A microcontroller board
	Datalogger shield	Adafruit LoggerPro v2	Responsible for data collecting
	LCD shield	3-Arduino 16x2 LCD Shield	Display data in real time.
 <small>SE-0018</small>	CO2 Sensor	K30 CO2 NDIR sensor to 1%	Collects CO2 gas by diffusion across the white semipermeable membrane on the sensor.

Fun Fact: A shield is a board that allows us to add unique technological components to serve a specific function.

Materials

Cables and Adapters

Picture	Name	Specification	Description
	Power Adapter	MChoice 9V 1A Power Supply Adapter 5.5x2.1mm Input 100V-240V for Arduino	A power supply independently for the Arduino Uno.
	USB Cable	USB A to B	
	USB to Pin Adaptor	K30 USB cable	A USB Cable for Address Change.
	SD Card	Micro SD card 16GB	Stores data collected by the data logger.
	Battery	Panasonic CR1220 3 Volt Lithium Coin Battery	



Materials

Additional Parts

Name	Sepecification	Description
Male female Header pins	Pin adapters to solder on boards	A male pin modified to work as an adapter to connect to a male pin.
Header Pins	pin adapters to solder on boards	A male pin connected to a female adapter.

Software and Code

Name	Link	Description
Arduino Software	https://www.arduino.cc/en/Main/Software	Arduino software used to create and add codes to your Arduino.
GasLab	https://gaslab.com/pages/software-downloads/	Gaslab program used to monitor gas levels in the area to compare with other sensors.
SD Card Reformatting	https://www.sdcard.org/downloads/formatter/	The SD Memory Card Formatter formats SD Memory Card, SDHC Memory Card and SDXC Memory Card complying with the SD File System Specification created by the SD Association (SDA).
RTC_SD_LCD_K30_v1.1.ino	Github.com/kkrueger/citizen_sensors	This code is downloaded into the finished assembly and allows for the arduino to communicate between the sensors, LCD screen and data logger.

Tools

These are tools you may need to assembly this project



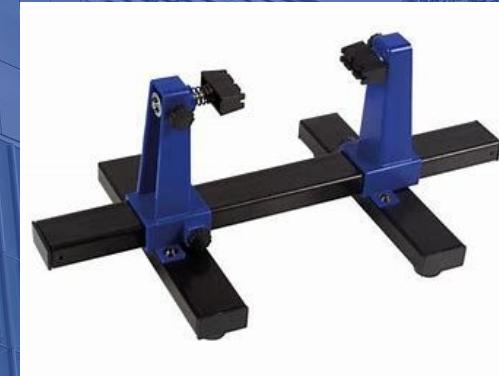
Multimeter



Soldering Iron and
Solder



Computer with USB port



PCB Clamp



Part Modifications

A few of the parts need to be modified from their out of the box assembly

CO2 Sensor Shield

Add Header (Connection) Pins

The K30 CO2 Sensor needs header pins soldered in order to be calibrated and connected to other devices.

1. Acquire the necessary materials for modifying the K30 sensor.
Header (connection) Pin Accessory. These need to be clipped to form the right size.
2. Locate where you will be putting the pins.
3. The Areas circled in blue are the pins for calibration.
4. The Areas circled in red are the pins for Communications and PC headers.
5. Place clipped header over proper location so the pins poke out the back
6. Solder the pins in the back
7. Cut the long ends that are sticking out.
8. Check conductivity with multimeter



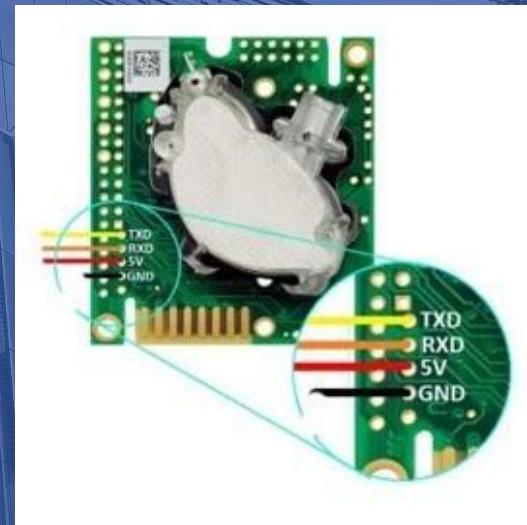
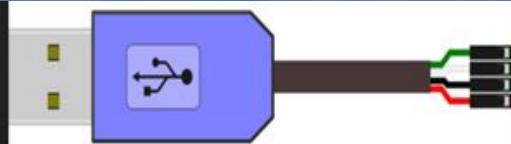
Part Modifications

CO2 Sensor Shield

Address Change

The internal code embedded in the K30 CO2 sensor needs to be modified so that it can communicate properly with the Arduino.

1. Connect k30 to USB-to-Serial cable as above.
Open Windows Device Manager. In Windows 10, bottom left where 'Type here to search', type 'Device Manager', hit enter.
2. Click on **Ports (COM & LPT)**.
Now connect the USB-to-serial cable and note which COM comes up (e.g. COM51).
Open Gaslab.
3. Select the com you identified from above (e.g. COM51) port from dropdown list, Kit: FITD(default), Product: SE-0018 at bottom of list.
Click 'connect'.
4. Check all ok by clicking on 'read sensor' a few times. (NOTE – Gaslab is not very stable and you may need to shut it down if it hangs. Use task manager (ctrl alt del) to terminate).
5. Once connected, go to 'configure sensor'.
While there make sure ABC is off and
6. Go to the 'Information' tab. Bus address will probably be 104.
Change 104 to 48. Set. Close
7. Disconnect from sensor (red button). K30 is ready.

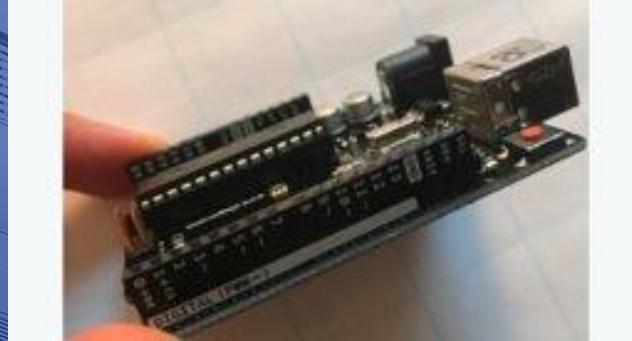


Part Modifications

Data Logger Shield

Header

Some data loggers come pre-assembled with header pins.
Others will need to be soldered on.

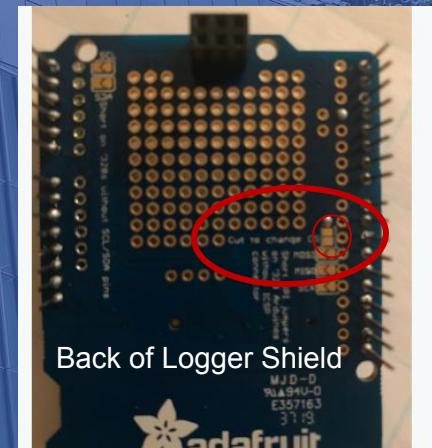


Goal 2: Add Long header for Logger

- Obtain necessary materials: Long Header that fits the Data Logger, a Data Logger
- Carry materials to the soldering area
- Identify which ports you will be adding the header to.
- Solder the header to the identified ports.
- Check for connection using a multimeter.

Goal 3: Jumper Pin and CS Scratch

2. The Data Logger shield board (Adafruit) must have the CS signal connected to pin3 with a wire and have the default connection to pin10 cut. There is a pad on the back of the board to do this with a knife.

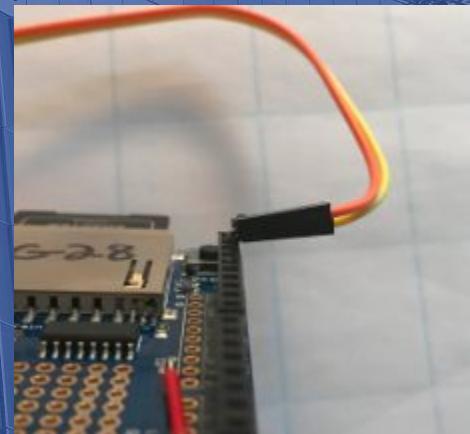
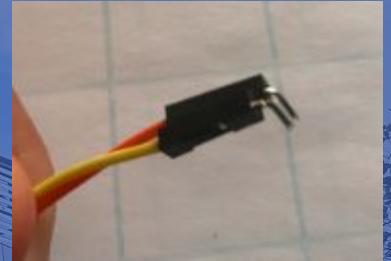
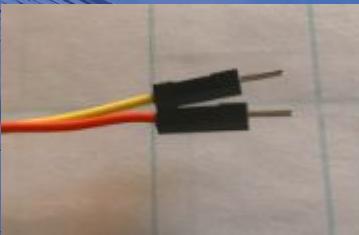


Part Modifications

90-degree Pin Adapter

An adapter needs to be made to connect the wires to the datalogger, which is hard to access once the logger and LCD screen are connected.

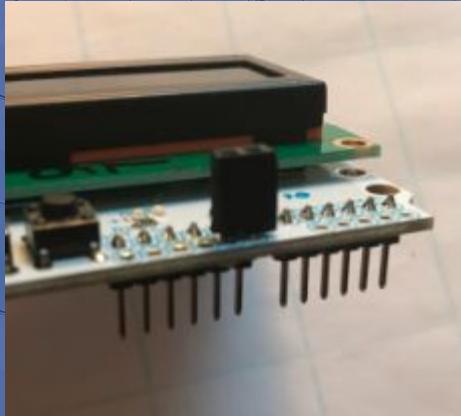
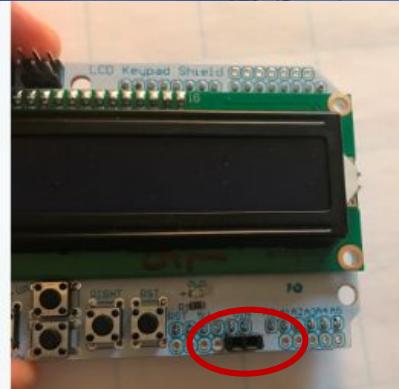
- **Goal 1: Modify Female to male to a 90 degree adapter**
- Obtain necessary materials: one male adapter and two pliers
- Set up materials where one plier is holding the adapter and the other pliers are equipped with another hand.
- Carefully place the pliers around the metal sticky part of the adapter.
- Squeeze pliers until you have a nice grip on the metal and slowly bend the metal at a 90 degree angle. It doesn't matter which way as long as the metal isn't damaged or too short for it to connect to a female adapter. Once it's bended and straight then you are all set!



Part Modifications

LCD Shield

Header pins need to be added for Power and Ground connections.



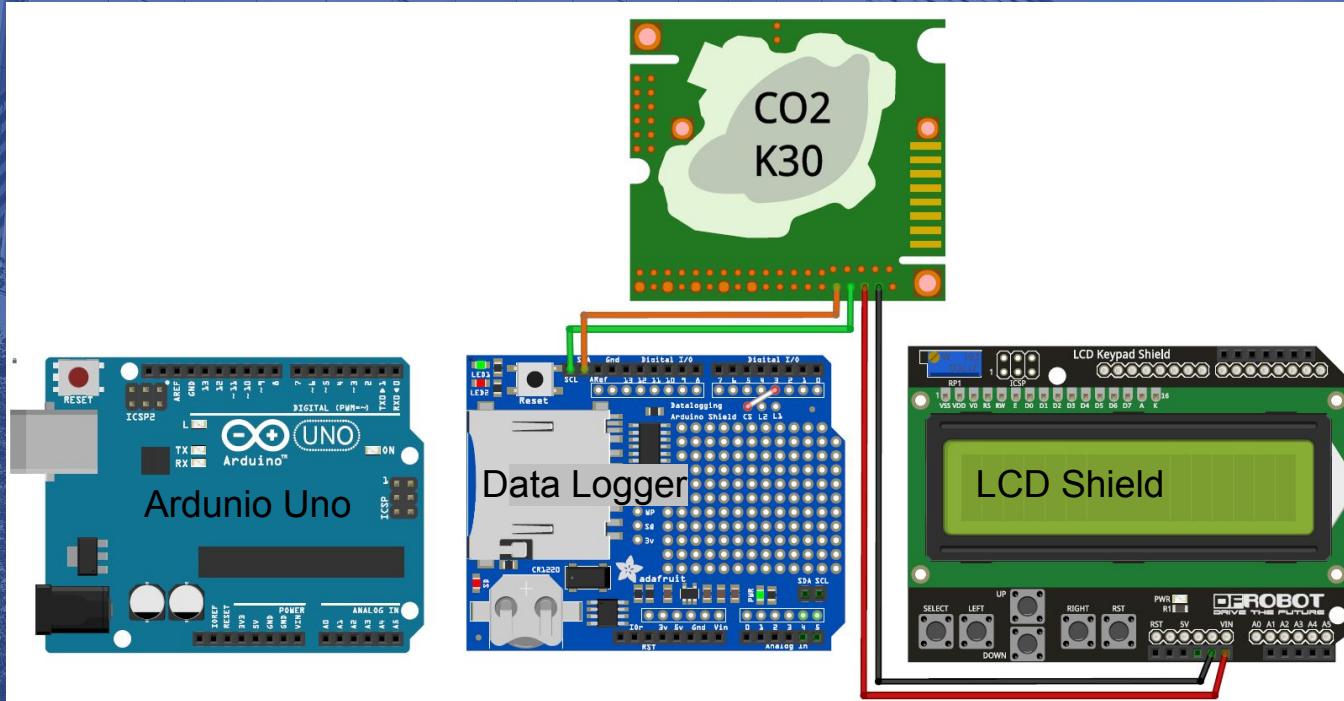
SD Card

SD Card needs to be formatted for proper data storage. Some come pre-formatted.

- Use software listed in the materials list to reformat the SD Card using your computer SD card reader or the USB SD card reader in the materials list

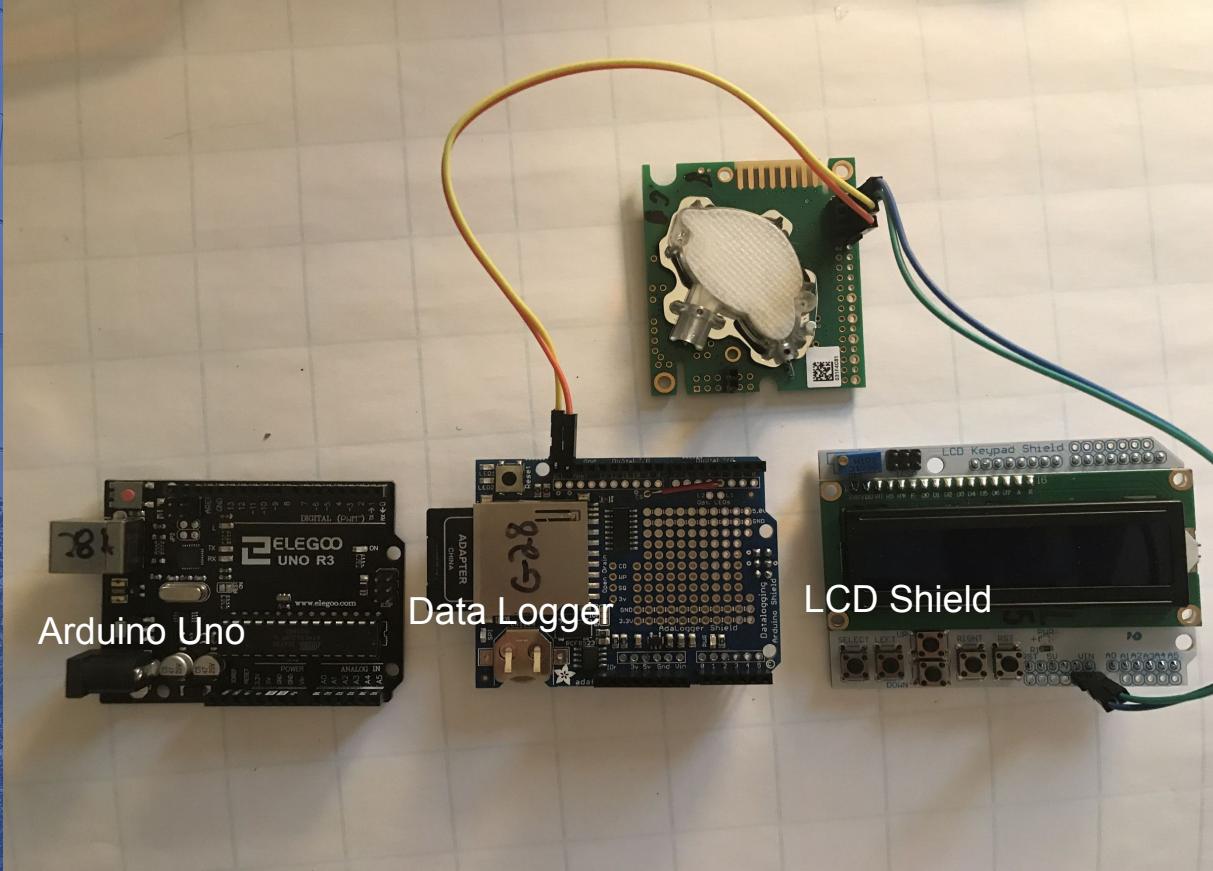
Assembly

The Schematic

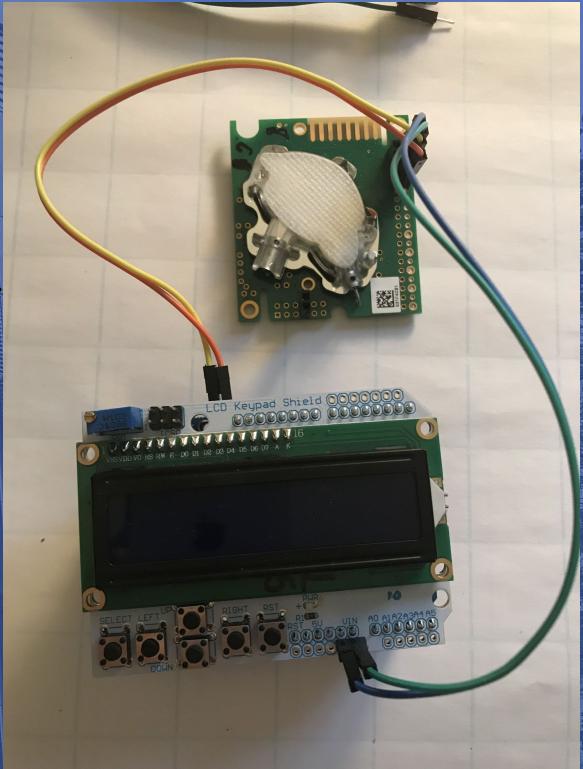
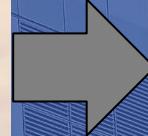
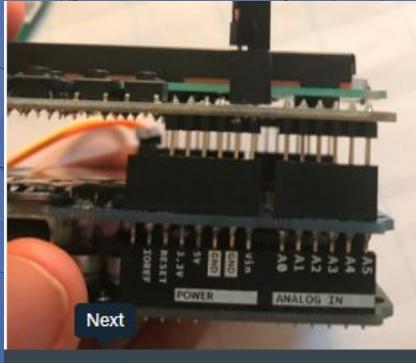
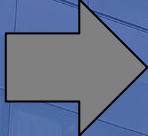


Assembly

The Real-Life Schematic



Assembly



Code

The sensor runs on a simple C+ code that is complied and downloaded through the Arduino software program.

The code we used is located here:<https://github.com/kkruege/citizen-sensors>

Along with a document explaining each section of the code

Filename: RTC_SD_LCD_K30_v1.1.ino

If you have any trouble, try googling your issue. There are a lot of resources and tutorials on the internet that can support.

Calibration



The calibration process helps make sure components are working and. As well as getting familiar with various programs such as Arduino Uno and Gaslab. If you don't have access to some of the materials then there are plenty of alternatives to choose from in calibrating the sensors. The protocol is found in the link below:

[https://github.com/kkruege/citizen-sensors/blob/master/Intro%20to%20Calibrating%20CO2%20sensors%20\(1\).pdf](https://github.com/kkruege/citizen-sensors/blob/master/Intro%20to%20Calibrating%20CO2%20sensors%20(1).pdf)



Data Retrieval

The data files are saved on the SD card in a text file format. This file can be opened in excel or google sheets using tab delimitation.

Here are some tutorials for how to graph the data and find trends:

Trial Data:

<https://docs.google.com/spreadsheets/d/1lyf93HVQVaNXBCZfQsmozrKSEtvsjz8jDgdSJRVUapg/edit#gid=0>

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