



Real-Time Display of Carbon Dioxide Contents at Local, National and Global Levels

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Project Description

Design and build a system that displays the carbon dioxide contents and ambient temperature of the locale where the kiosk is installed. Additionally, the system will display the average carbon dioxide contents of the United States, and the globe. The system should wirelessly send the information to a website for display. The system will also house a built-in user interface which will be navigable via touch gestures on the display panel.

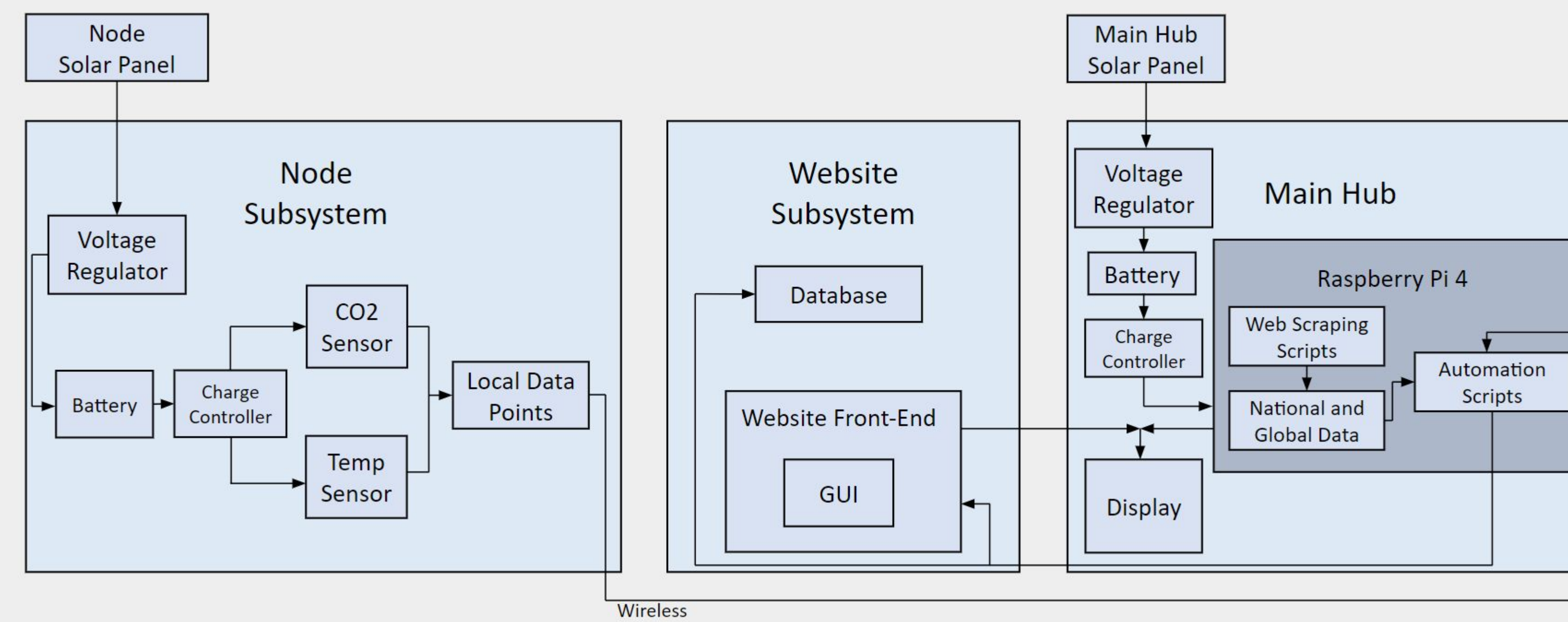
System Specifications

- ❖ Display is visible from a distance of 10 feet
- ❖ Report both the local Carbon Dioxide contents and ambient temperature
- ❖ Have a user interface (UI)
- ❖ Pull data from specific/approved websites
- ❖ Sensor nodes and main hub are powered for 24 hours a day
- ❖ System is powered completely by solar panels
- ❖ Display accurate and government-approved data
- ❖ Have clear and easily discoverable data within the display interface
- ❖ Comply with ADA, HIPAA UL, Made in America, and Environmental standards/regulations
- ❖ Be operable for a minimum of two years

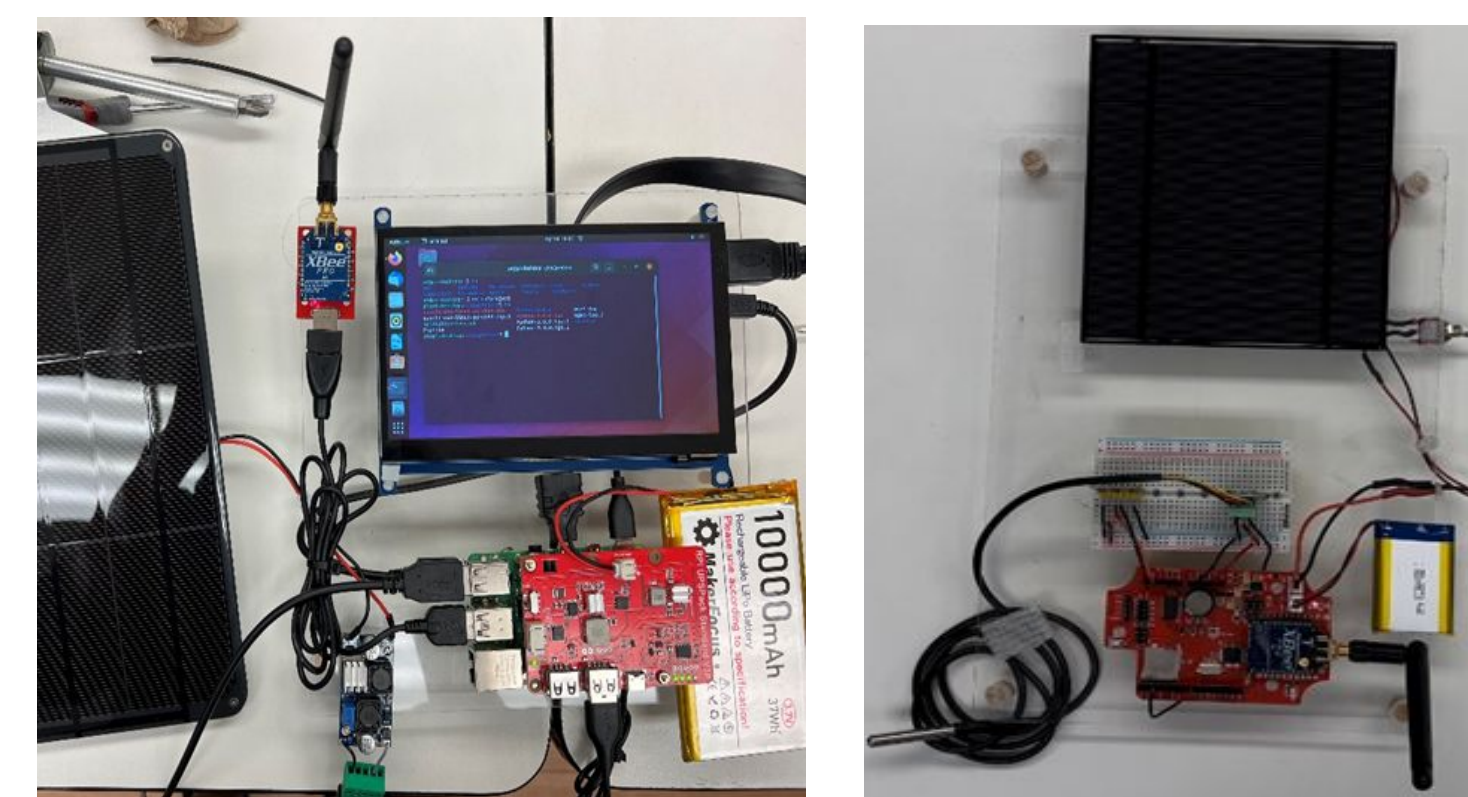
Hardware Components

1. Hub Microcontroller: Raspberry Pi 4 Model B
2. Node Microcontroller: Seeeduino Stalker V2.0
3. Temperature Sensor: DS18B20
4. CO2 Sensor: CCS811 Air Quality Sensor
5. Display: Waveshare 7-inch Capacitive Touch LCD
6. Solar Panels: 2.5W 5V ALLPOWERS & 9W 6V panel from storage room
7. Voltage Regulators: Makerfocus UPS pack, DC/DC buck boost converter, CN3065 Solar Charger
8. Hub/Node Battery: Makerfocus 3.7V, 10Ah/MusiBeauty 3.7 2.2Ah

Low-Level Design for the System



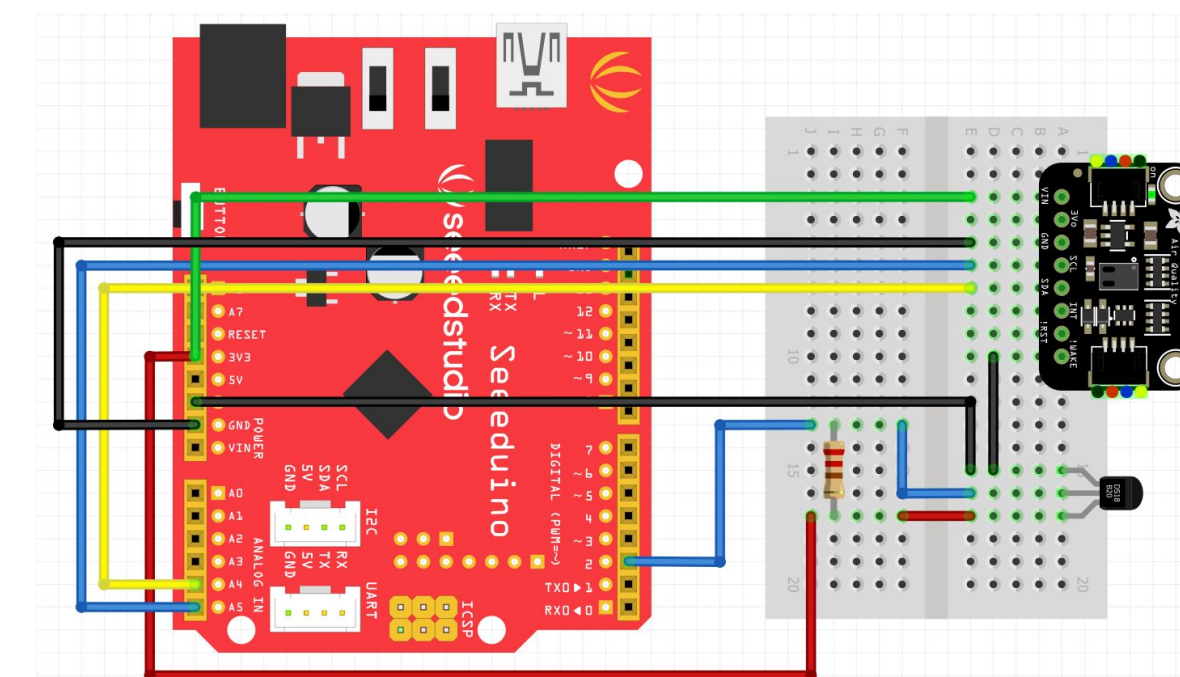
Working Node and Hub



Power Budget

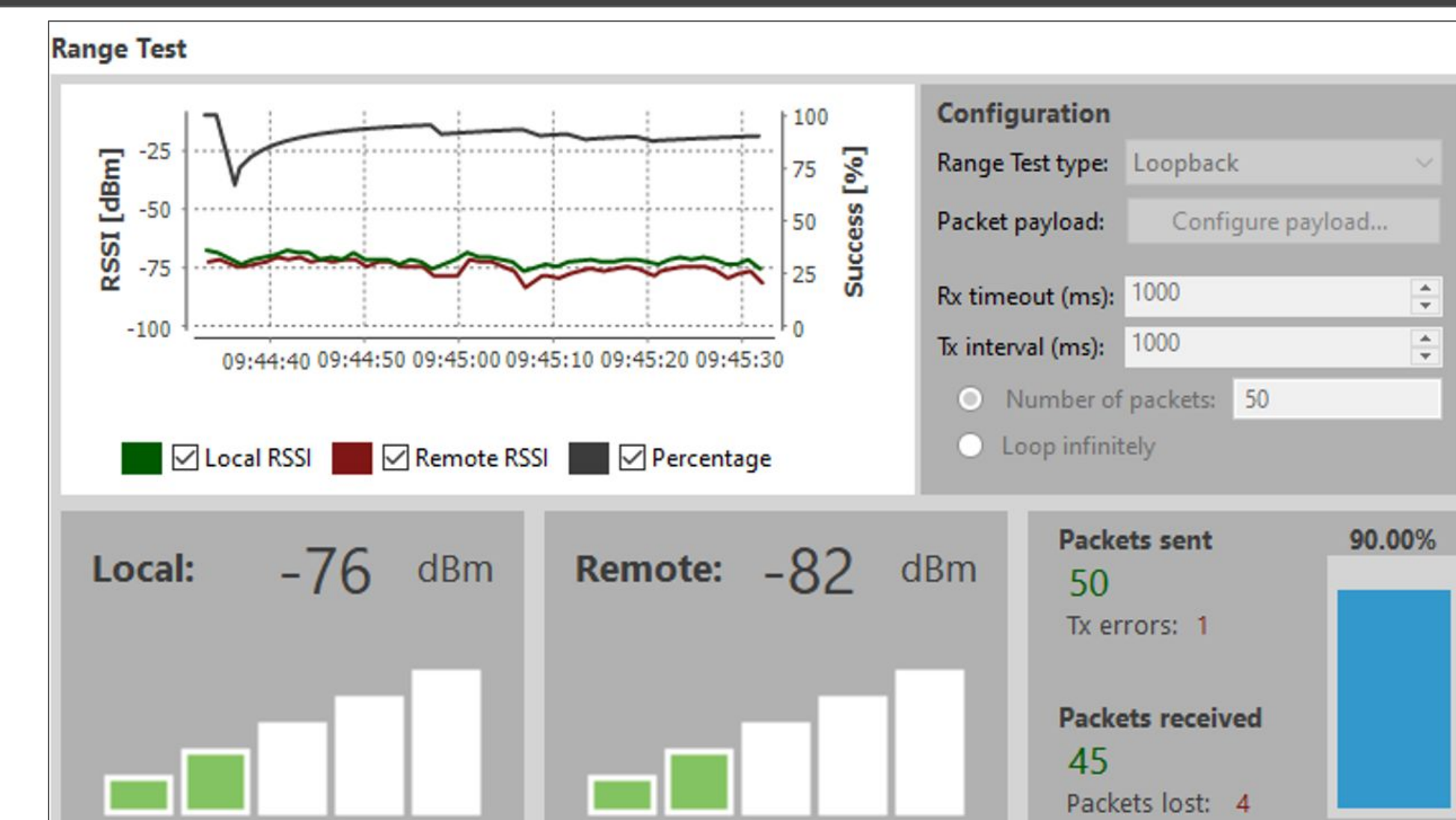
	Node				Kiosk		
Device	Voltage (V)	Current (A)	Power (W)	Device	Voltage (V)	Current (A)	Power (W)
CO2	3.3	0.054	0.1782	Raspberry Pi 4B	5.1	3	15.3
Temp	3.3	0.015	0.0495	7" display	5	0.49	2.45
Xbee	3.3	0.215	0.7095	Xbee	3.3	0.215	0.7095
Seeduino	5	0.35	1.75	Battery	3.7	3	11.1
Battery	3.7	3	11.1	Solar Panel	7.2	1.37	9.864
PV	5	0.5	2.5	Total	13.4	3.705	18.4595
Total	23.6	4.134	2.6872	Measured	5.13	1.1	5.643
Measured	5.499	0.084	0.461916				

CO₂ and Temp Sensor Measurements



```
Working with [NODE 1]
Incoming Data Type: <class 'bytes'>
Data Received: b'1\t21.69\t400\t14'
Converting Data to: <class 'str'>
Converted Data: ['1', '21.69', '400', '14']
Expected Packet Length: 14
Actual Packet Length: 14
Saving Packet to File...
Packet Saved on: Mon Mar 7 15:47:21 2022
```

Wireless Communication



Radio Frequency Range Loopback testing between two XBee RF modules. The system should be able to collect sensor data from various nodes across the campus, and wirelessly transmit the contents to the main hub. Optimizing the range for node placement and gauging signal loss is important to establishing a reliable network.

Website Build

Website QR Code:

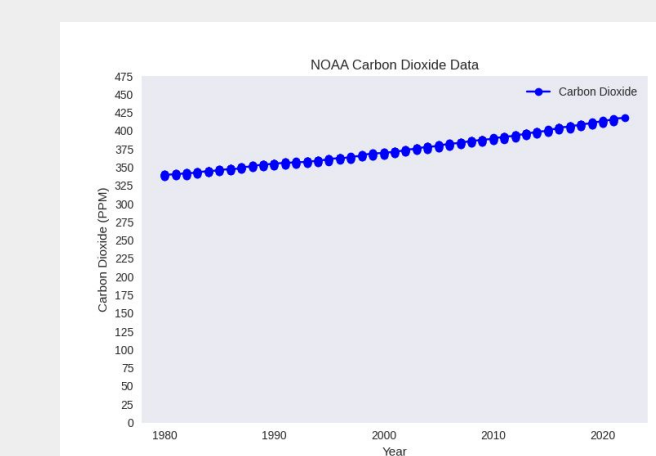


Estimated Cost

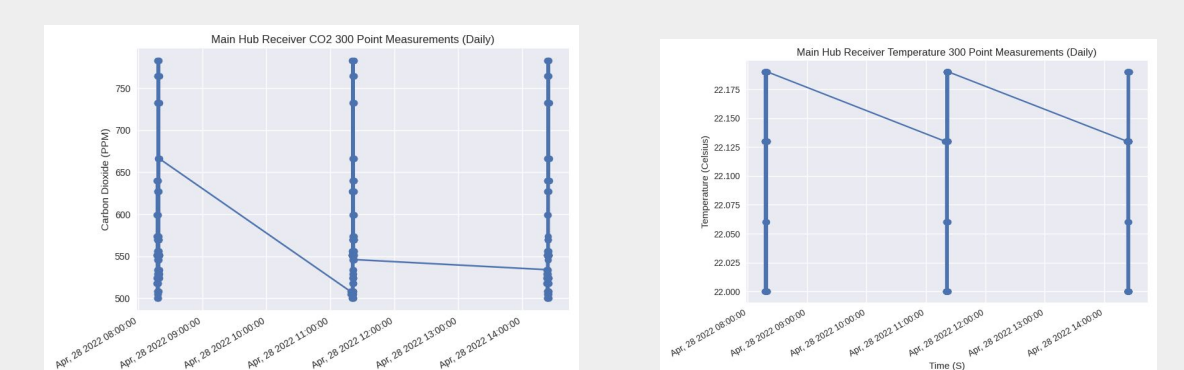
Item Type	Item Name	Price
Microcontroller (node)	Seeeduino Stalker	\$19.90
Microcontroller (hub)	Raspberry Pi 4 B	\$35
CO2 Sensor	Keystudio CCS811	\$22.00
Temperature Sensor	DS18B20	\$8.99
Wireless Communication	XBee Pro S1 RF Module	\$24.95 (x2)
Display	7-inch capacitive touch LCD	\$52.99
Power Source (hub)	9W Solar Panel (item SOL018)	\$79.00
Power Storage (hub)	10Ah LiPo Battery	\$18.59
Charge Controller	4000mAh RPi UPSPack	\$25.59
Power Storage (node)	2.2Ah LiPo Battery	\$19.89
Power Source (node)	5V Photovoltaic Panel	\$11.69
DC/DC Converter	Buck Boost Voltage Regulator XL6009	\$11.99
Total (hub + 1 node)		\$355.44

Automation Output

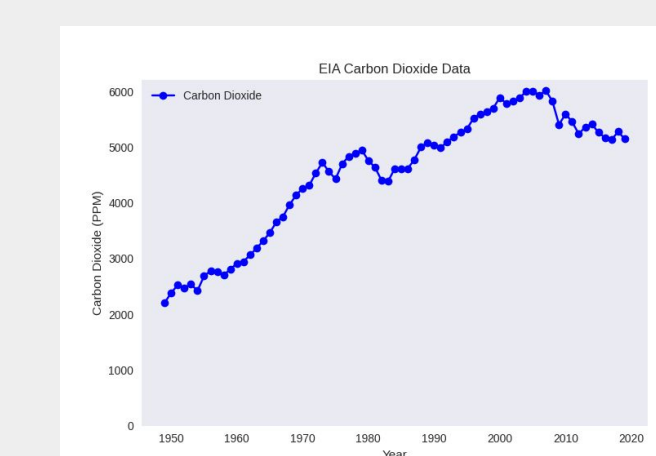
Webscraping for NASA



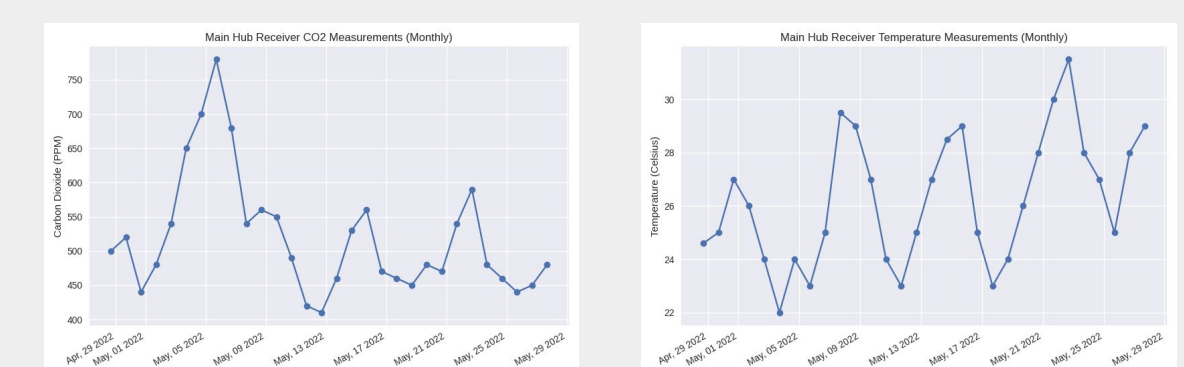
Local Plot - Daily



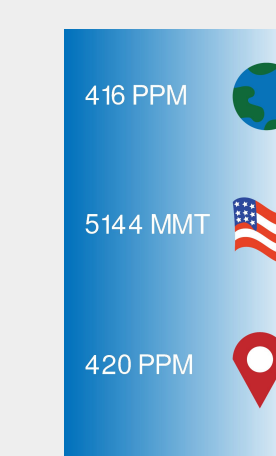
Webscraping for EIA



Local Plot - Monthly



Kiosk Mode



Local Plot - Yearly

