

Weather Tunnel : Sensor Data sheet

>> Technology Overview and Data Schematic

Each *Weather Tunnel* collaborator will be setting up their own local data collection 'node', feeding and sharing local environmental data for use by all other institutions. In order to do this, we'll be utilizing custom hardware and software. This document will provide an overview as to how we will be capturing, sharing, and accessing all data.

Hardware

Each collaborator will receive a *Weather Tunnel* sensor module. These boxes are meant to be placed outside, however there are several considerations to be made before installation. The sensor module requires access to two things: power (110v or 220v is fine) and a hardline Ethernet connection to the internet with a static IP address. Each module will arrive to you pre-programmed to connect from a specific IP address which you will need to identify (and share with us, see '*Identifying your IP Address*') before receiving it.



The sensor module is designed to be installed outdoors and able to survive moderate to medium-heavy rain in all temperatures. However, if it is heavily raining outside your window, please feel free to bring it inside for that period of time.

The modules are outfitted with sensors for measuring:

- ambient light
- ambient sound
- temperature
- humidity
- carbon monoxide (CO)
- carbon dioxide (CO₂)
- general air quality (NO_x, smoke)

The sensors themselves are located beneath two PVC dome shields. The smaller dome contains temperature, humidity, and ambient noise sensors. The light sensor is housed in the body of the module. The remaining gas sensors are located in the larger dome. These are housed separately, as their sensing mechanism involves heating a gas-specific sensitive element. The heat could damage the other sensors, so they have been isolated.



Each dome has 4 holes for air to enter and flow through. A mesh has been adhered to the inside of the holes to prevent large particles of moisture or debris to enter the sensor housing. The domes are removable and have not been permanently attached. This is to allow you to rotate them as needed so the holes point away from your building, for instance.

Setup: The modules have been designed to be 'plug and play'. Upon receiving yours, simply connect the Ethernet cable (connected through the static IP address you

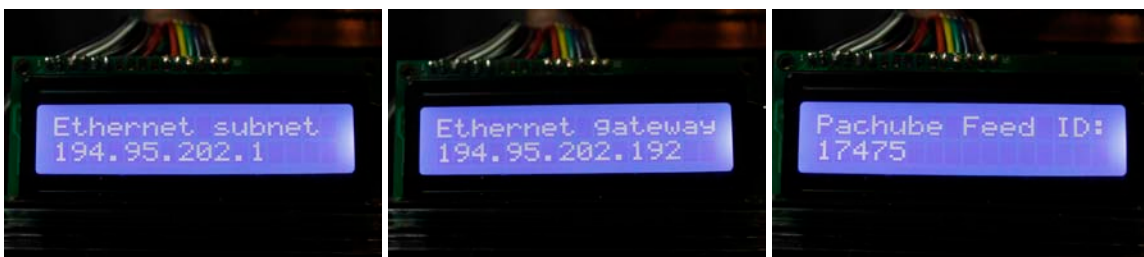
identified to us when requesting your unit), and then the power supply, which is included in the package you have received. The unit will turn on and immediately begin reading it's sensors and posting data online.



A few notes: Once you've begun posting data successfully, it will take 2 – 3 days for all of your data to 'normalize'. This is because several of the gas sensors using analog filaments for sensing pollutants. They require this amount of warm-up time before they are stabilized. Be sure to leave the unit powered at all times. It is also normal for the unit to warm up. Both the gas sensors as well as the body itself will heat up. This is normal, do not be alarmed.

LCD Messages: Each unit is equipped with an LCD screen that displays constant status messages. Here is a quick overview of each message.

Upon powering your unit, you will be greeted. An initialization sequence will follow. The initialization sequence will display the IP address, Subnet Mask, and Gateway Address that have been programmed into your specific unit. *These must match the addresses of the specific Ethernet port you have connected the unit to!* It will also display your node's specific Pachube Feed ID.

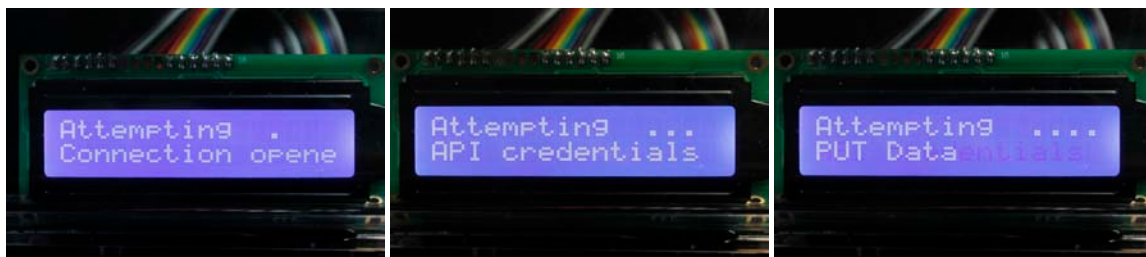


This initialization sequence will display each time the unit has been powered or reset. Following this setup, the unit will begin reading data from the sensors.



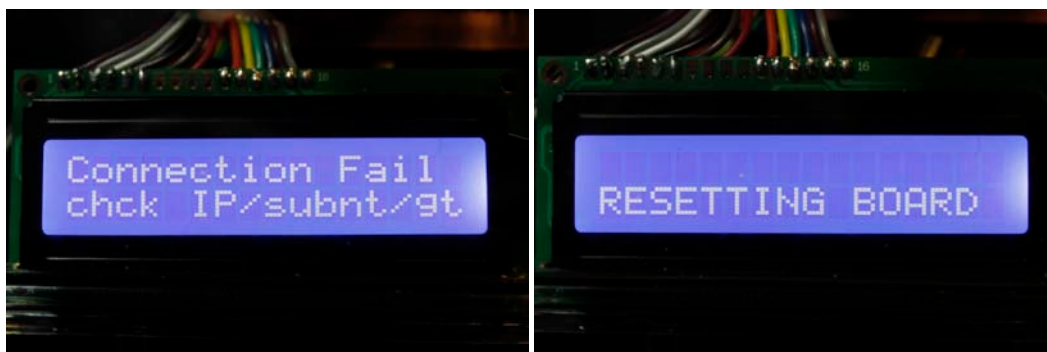
While the unit is taking measurements, it will display “SENSING >>” in the top left corner. On the right side of the top line is the number of seconds that have passed since the last successful data upload. This number will never go above 120sec. On the second line you’ll see the sensor being read at that moment. To the right of this, the value of the reading taken at that moment. During this time, a blue LED will be pulsing on and off letting you know from a distance that sensors are being measured.

Every 30-40 seconds, the unit will attempt to upload the latest readings.



These messages are mostly for debugging purposes. The display will update as the unit goes through each step of connecting to the Pachube server. If all is well, these should cycle quickly. If the connection attempt was successful you will see the message “Data Sent!” on the screen. The unit will now return to reading the sensors.

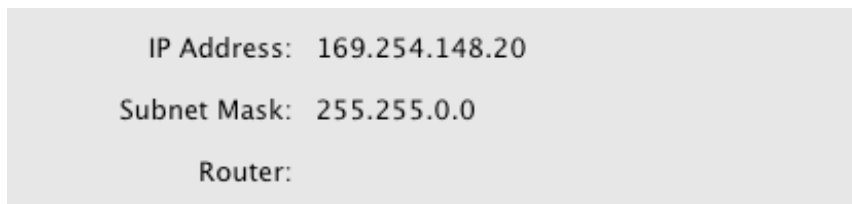
If there were problems during the upload process, you will see the message “Connection Fail check IP/subnet/gateway”. If the connection fails repeatedly and no successful upload has been made in over 2 minutes, the board will reset itself. If you notice that the board is never able to connect, and simply resets itself repeatedly, please read the troubleshooting section.



Troubleshooting: If your unit seems unable to make any connection at all with the server, the problem is most likely with the addresses programmed into the unit.

1. Unplug the power supply from the unit, and then replug. This resets the microcontroller and will allow you to see what addresses the unit is attempting to use.
2. Make a note of the three addresses displayed on the LCD screen as the unit powers up (IP, subnet, gateway).
3. Disconnect the unit from the Ethernet port.
4. Connect a laptop to the internet through the very Ethernet port the unit was previously connected to.
5. Once connected to the internet, compare the addresses used by your computer to those noted from the unit.
6. If they are identical addresses, the problem is physical. Perhaps the Ethernet coupler in the box has become loose. Or perhaps something in the box has died. Email Joe (saavedra@jos.ph) and describe the situation, it is possible a replacement is needed.
7. If the addresses are different, email Joe and describe the situation. It is indeed possible for you to reprogram the unit with the correct addresses, however it will require about 20 minutes of your time (assuming no experience with Arduino), and a computer.

Identifying your static IP address: Once you've found a window that is suitable (near an Ethernet internet connection and power outlet), you'll need to send us that specific IP address, Subnet Mask, and Gateway (if applicable) so we may program your unit properly before sending it to you. This is very simple. Connect a computer to this port and make sure you are able to go online. Then, in OS X, navigate to System Preferences > Network and select the Ethernet connection you are plugged in to. Then simply take note of and send us the following information:



IP Address: 169.254.148.20
Subnet Mask: 255.255.0.0
Router: _____

Note: If you know you are behind a firewall, we also need the Gateway address through which you can connect.

Pachube

So, your unit is plugged in and has a glowing blue LED and the LCD screen is reading "sensing..." and periodically flashing "data sent!". This is an excellent sign. But where is this data going? And how can we get to it. For this, we are using an amazing online tool called Pachube. Visit Pachube.com to jump in.

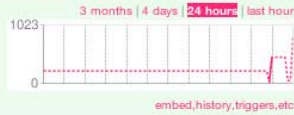
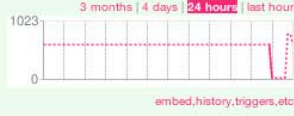

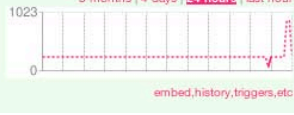


Each “node” will have it’s own Pachube feed to which it will be posting live data. You can see all of Weather Tunnel’s nodes by visiting:

<http://www.pachube.com/users/weathertunnel/feeds>

You can find your feed in this list, and view your data online here.

Your unit will update data approximately every 30 seconds, and this is visible in the line graphs on the right side of the feed page.

ID	Tags	Value	Units	Embeddable graphs & tools
0	carbon monoxide	239	ppm	 embed, history, triggers, etc
1	noise pollution	760	db	 embed, history, triggers, etc
2	methane gas	362	ppm	 embed, history, triggers, etc
3	light exposure	191		 embed, history, triggers, etc

Pulling data from Pachube

Pachube is an excellent tool because it has a very well documented and versatile API with data available as XML, CSV, or JSON feeds. You can read about the API here:

<http://api.pachube.com/>

Using the Pachube API, it is very easy to begin writing live applications that pull data any number of feeds in real-time. We encourage you to use data from as many nodes as possible in your piece. All feeds and necessary API access info will be available on the Weather Tunnel blog as nodes around the world begin to get setup and running.

When you begin writing your custom applications to interface with Pachube, you will need an API key. This key will give you access to all of our feeds and their data in any form, in real-time.

Weather Tunnel Pachube API Key:

10_57fcWGXJjGhp21d1yJdYd-9DaXx2oYpjQ0sfdGCA