# WORKSHOP ARGENTINA
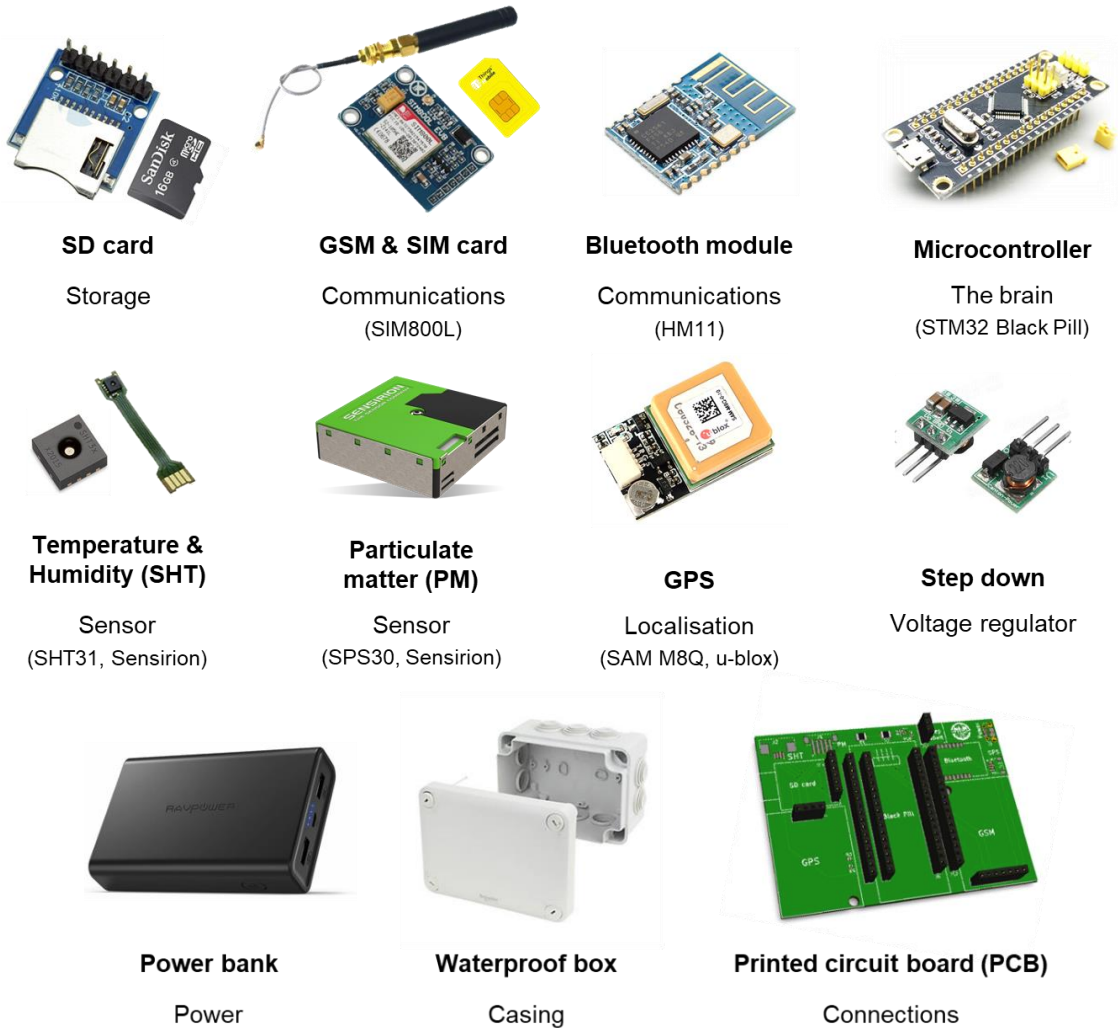
ASSEMBLE A MOBILE AIR POLLUTION MONITORING DEVICE

## 1.0 MATERIALS AND COMPONENTS

Main components:

**SD card**

Storage

**GSM & SIM card**

Communications
(SIM800L)

**Bluetooth module**

Communications
(HM11)

**Microcontroller**

The brain
(STM32 Black Pill)

**Temperature & Humidity (SHT)**

Sensor
(SHT31, Sensirion)

**Particulate matter (PM)**

Sensor
(SPS30, Sensirion)

**GPS**

Localisation
(SAM M8Q, u-blox)

**Step down**

Voltage regulator

**Power bank**

Power

**Waterproof box**

Casing

**Printed circuit board (PCB)**

Connections

Other materials you will need for the assembly:

- Cables
  4x colour short cables (for GPS)
  5x black longer cables (for PM sensor)

- Connectors
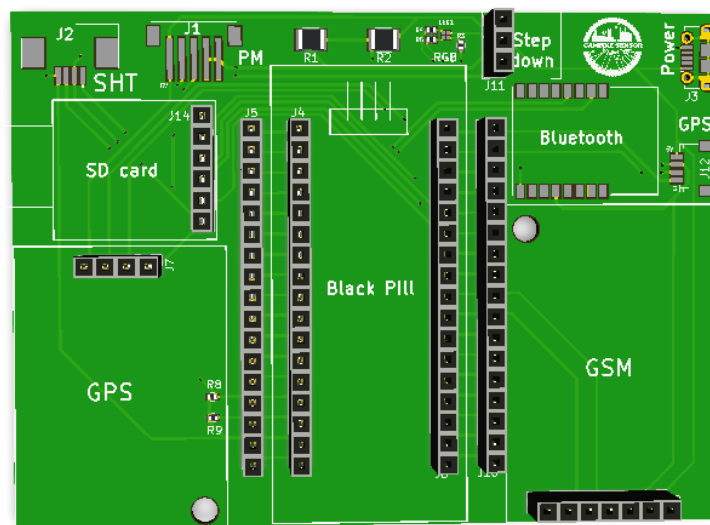  2x 4 pin (for GPS)
  2x 5 pin (for PM sensor)

- Fixing materials
  Foam
  Velcro
  Cable ties



## 2.0 ASSEMBLY

1. Have a look to the printed circuit board (PCB). You should see the name of each of the components next to the place where they should be plugged in, either directly or through a connector.
   Ask if you have any doubts about which component is which or how to connect them!



2. Start plugging the components that have pins into the black pin sockets. You should plug in:
   a) the Black Pill microcontroller (check in which direction following the drawing on the PCB!)
   b) the GSM module
   c) the step-down voltage regulator
   d) the SD card module



The only module that is not plugged in is the GPS. Don't forget to put the SD card in the SD card module and the SIM card in the GSM module! Plug in the GSM antenna as well.

3. Prepare the connectors for the GPS and the PM sensors:

**Connecting the GPS**

Plug the white connector into the GPS and then plug the red cable into the connector where it says 5V. You should feel a "click" when the red cable is properly connected. Make sure you plug the cable in the connector in the correct orientation- the small metal protrusion should be aligned with the narrow end of the white connector, as indicated by the green arrows in the diagram. If in doubt, ask to check before plugging it in!
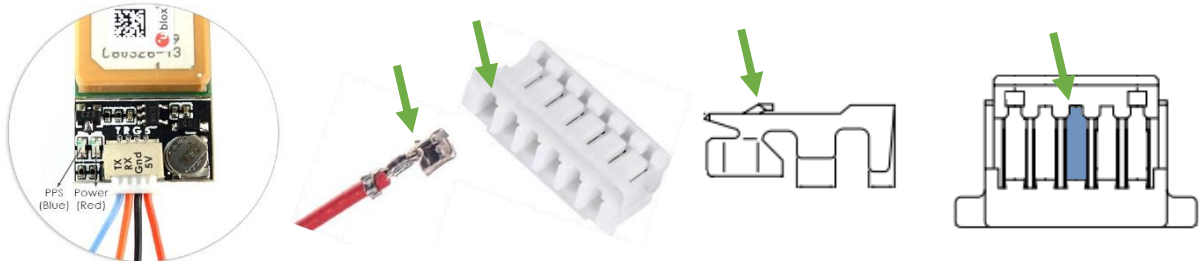


Do the same at the other end of the cables, plugging the second white connector into the PCB board first and then plugging the red cable in the side of the connector where 5V is written on the board, as shown below.



Plug the rest of the cables into the connectors, following the same order: black for ground (GND) and two colours of your choice for the communication pins (TX and RX).

**Connecting the PM sensor**

Following the same procedure as for the GPS, plug the white 5 pin connector to the PM sensor. Pin 1 (to the left) is the 5V pin. Connect the cable and plug it to connector on the PCB, where 5V is written on the board. Then follow the same order for the rest.
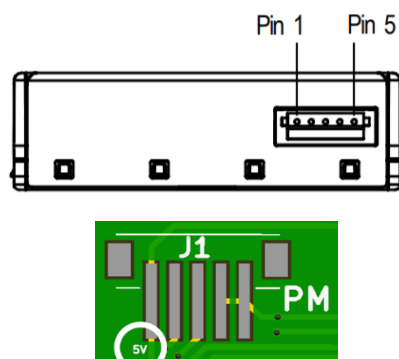


| Pin | Name | Description | Comments |
|-----|------|-------------|----------|
| 1 | VDD | Supply voltage | 5V ± 10% |
| 2 | RX | UART: Receiving pin for communication | TTL 5V and LVTTL 3.3V compatible |
| | SDA | I²C: Serial data input / output | |
| 3 | TX | UART: Transmitting pin for communication | TTL 5V and LVTTL 3.3V compatible |
| | SCL | I²C: Serial clock input | |
| 4 | SEL | Interface select | Leave floating to select UART |
| | | | Pull to GND to select I²C |
| 5 | GND | Ground | |

*Datasheet of Sensirion SPS30 PM sensor*

4. Connect the temperature and humidity sensor:

   Slide the black part of the connector out and clip the humidity sensor in it with the pads looking up. Then reinsert the black connector so the pads are held in place.
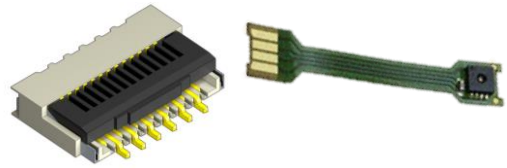
5. Plug in the power bank using the micro USB cable.
6. Open box and place components inside.
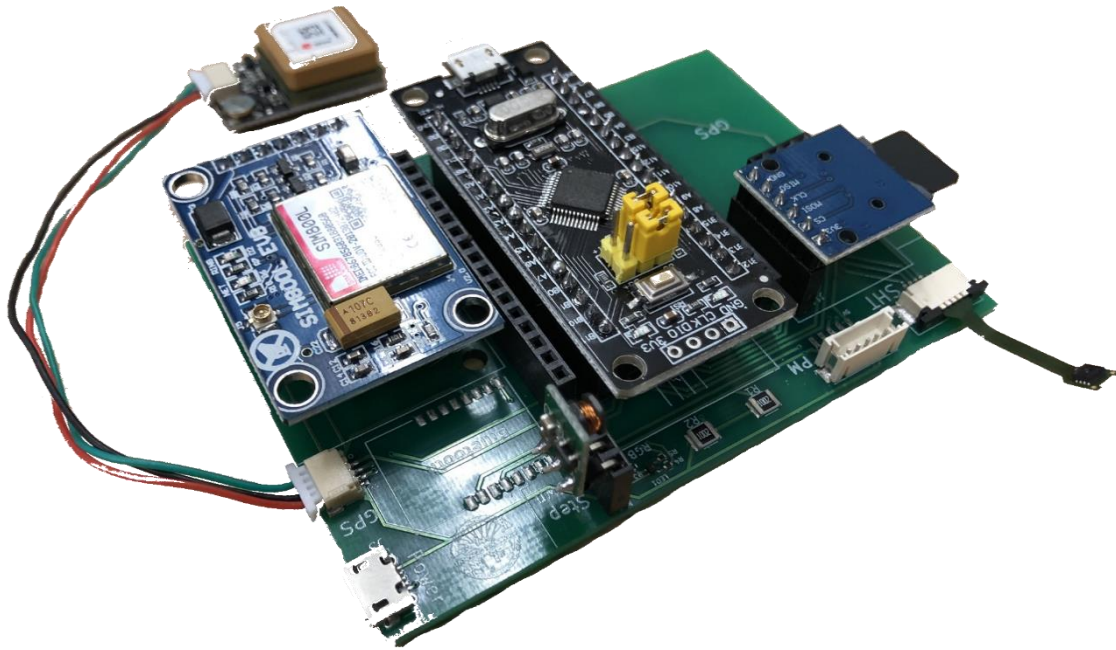
Check the photos above to get an idea of how to place the sensors within the box. You need to cut some of the rubber box outlets. To keep everything in place you might want to use Velcro tape and some foam. We will help you with these steps.

## 3.0 Data Collection

After assembly you should be able to turn on the power switch and see status LEDs flashing. The sensor is ready for data collection and will log to its internal SD card as well as to the

server via GSM. Using the 10.000mAh battery we provide it should be able to run up to 5 days continuously with 1 full charge.

# 4.0 Data Uploading and Analysis

## *User creation and accessing the file manager*

- Go onto http://app.open-seneca.org
- Click on the link for registration in order to get a user
- Choose a username (special characters are not allowed)
- If SIM card data later is desired, a SIM card number must be provided in the registration form
- Once the registration is complete, you will be forwarded to the file manager that is also linked to at http://app.open-seneca.org
- Log in using your newly created user

## *Uploading data and visualising*

After entering the file manager, the interface below will be shown
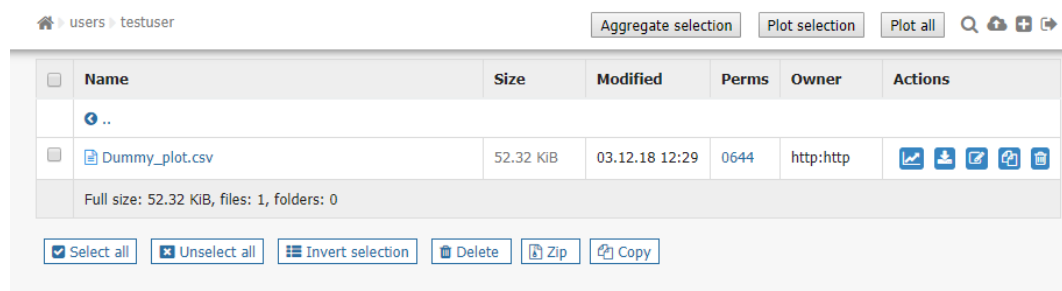


In the upper right corner, there are buttons (from right to left) to sign out, create a folder and upload data. Clicking the button to upload brings up the following panel:
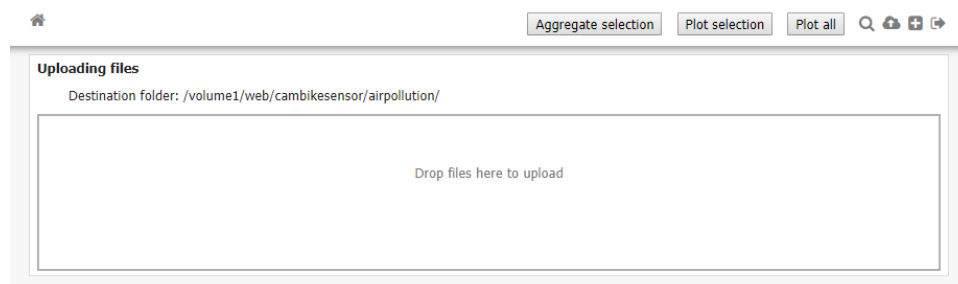


Clicking the panel allows selection of local files in a file dialogue for uploading. Alternatively, one or more files can be dragged from a folder on your PC and dropped into the panel to upload them.

In the file manager interface every file has an associated set of buttons:

These do the following (from right to left): plot the data from the file, download the file, rename the file, copy the file and delete the file.

If a plot of multiple files is desired, the buttons in the top "Aggregate selection", "Plot selection" and "Plot all" should be used. A selection is made by checking the boxes in the leftmost column of every file of interest, e.g. the following selection of three files:

| | Name | Size | Modified | Perms | Owner | Actions |
|---|---|---|---|---|---|---|
| ☐ | ⬅ .. | | | | | |
| ☐ | 📄 10000.csv | 24.34 KiB | 28.03.19 07:02 | 0644 | http:http | 📈 ⬇ ✏ 📑 🗑 |
| ☑ | 📄 10001.csv | 829 B | 28.03.19 07:02 | 0644 | http:http | 📈 ⬇ ✏ 📑 🗑 |
| ☐ | 📄 10002.csv | 9.19 KiB | 28.03.19 07:02 | 0644 | http:http | 📈 ⬇ ✏ 📑 🗑 |
| ☑ | 📄 10003.csv | 3.9 KiB | 28.03.19 07:02 | 0644 | http:http | 📈 ⬇ ✏ 📑 🗑 |
| ☑ | 📄 10004.csv | 625 B | 28.03.19 07:02 | 0644 | http:http | 📈 ⬇ ✏ 📑 🗑 |
| ☐ | 📄 Dummy_plot.csv | 52.32 KiB | 28.03.19 07:01 | 0644 | http:http | 📈 ⬇ ✏ 📑 🗑 |
| | Full size: 91.17 KiB, files: 6, folders: 0 | | | | | |

☑ Select all    ✖ Unselect all    ☰ Invert selection    🗑 Delete    📄 Zip    📑 Copy

The "Plot selection" visualisation overlays the tracks of data on top of each other. This may be good to get an idea for how well tracks overlap as they will all be individually drawn, although the tracks may occlude each other. The "Aggregate selection" combines the data in the files to come up with an best estimate for the covered area – below is an example.