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Agriculture MVP

LoRa Weather Station – Assembly Guide

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1. INTRODUCTION

This document describes the development of a LoRa Weather Station using low-cost hardware that together will communicate with LoRa Gateway. In order to develop this solution, multi-technology sensors were used as part of the IoT sensor node with LoRa network integration.

The challenge was to develop an easy-to-deploy solution capable of acquire data from the surrounding area and then making it available to the Waziup Cloud Platform. This solution uses several components that are easily bought on the market and can be potentially replaced by equivalent models.

This work was done in the context of Waziup Research Project, which has received funding from the European Union's H2020 Programme for research, technological development and demonstration under grant agreement No 687607.

2. COMPONENTS

The objective is to develop a low-cost and sustainable solution capable of reading real-time data typical of a Weather Station, using different sensors, and capable of communicating via LoRa.

The components required was:

- Adafruit Feather M0 with RFM95 LoRa Radio
- Sparkfun Weather Shield
- Weather Meters
- 4,5 dBi 868-900 SMAM-RP Antenna
- uFL SMT Antenna Connector
- RP-SMA to uFL/u.FL/IPX/IPEX RF Adapter Cable
- 2x RJ11 6-Pin Connector
- 36-pin 0.1" Female header - pack of 5
- Adafruit AM2315 Sensor
- 1.5W Solar Panel 81x137
- Lithium-Ion Battery - 3.7v 2200mAh
- Schottky Rectifying Diode
- Waziup Weather Station PCB
- 3x DG300-5.0 Connector

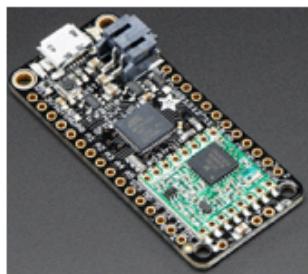
The use of all this material allowed the development of the "LoRa Weather Station" solution that cost less than 200€ and is available on the IoT-Catalogue platform through the following link¹. In Figure 1 are represented the respective materials mentioned above.

The next sections provide a step-by-step tutorial on how to build the LoRa Weather Station in order to collect data and send them to the gateway.

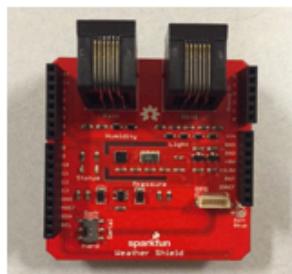
First, it is necessary to assembling the chosen components, and then upload the software. All the information used for this Weather Station is open-source and hosted in the Waziup GitHub repository².

¹ <https://www.iot-catalogue.com/products/59b1797c763fcf066f6d092b>

² <https://github.com/Waziup/WAZIUP-WeatherStation>



Adafruit Feather M0
with RFM95 LoRa
Radio



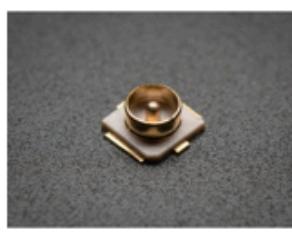
Sparkfun Weather
Shield



Weather Meters



4.5 dBi 868-900
SMAM-RP Antenna



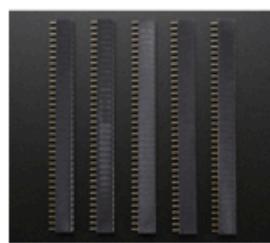
uFL SMT Antenna
Connector



RP-SMA to uFL
Adapter Cable



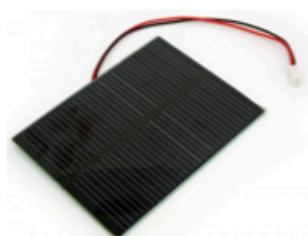
2x RJ11 6-Pin
Connector



Female headers
pins



Adafruit AM2315
sensor



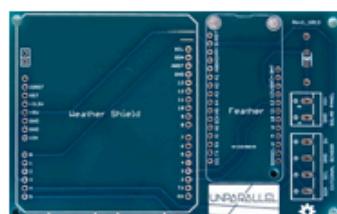
1.5W Solar Panel



Lithium-Ion Battery



Schottky
Rectifying Diode



Waziup Weather
Station PCB



3x DG300-5.0
Connector

Figure 1 – Components chosen

3. ASSEMBLY WEATHER STATION

Before connecting all the components, it is necessary to perform delicate but simple solder task. Is recommended to train a little by following a guide as Adafruit³.

3.1. Solder Components

3.1.1. Adafruit Feather

The Adafruit Feather M0 comes with fully assembled and tested radio but is necessary solder the female header pins in Feather by following the Adafruit guide⁴. In Figure 2 can be seen the Adafruit Feather M0 after solder the female header pins.

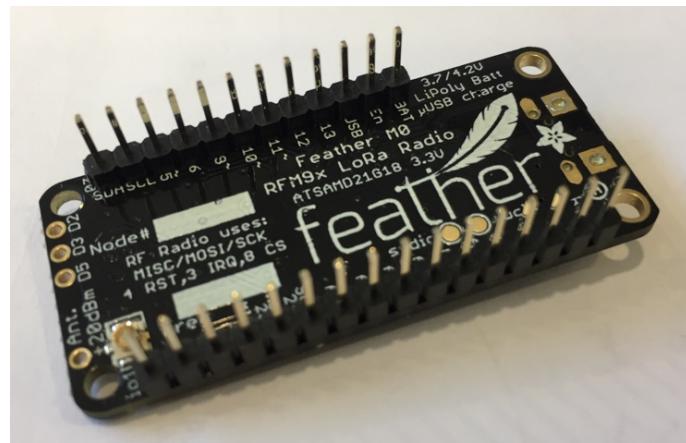


Figure 2 – Female Header pins in Feather

3.1.2. uFL Antenna Connector in Feather

To use an 865MHz Antenna, it is required to solder the “uFL SMT Antenna Connector” in the Adafruit Feather M0 by following the steps in the Adafruit guide⁵.

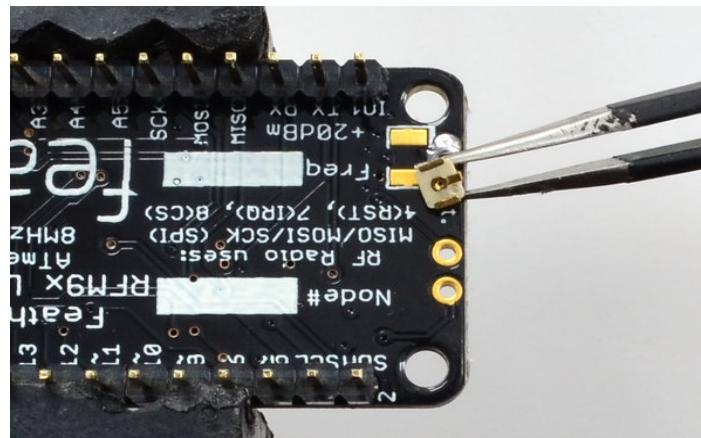


Figure 3 – uFL SMT Antenna Connector in Feather

³ <https://learn.adafruit.com/adafruit-guide-excellent-soldering>

⁴ <https://learn.adafruit.com/adafruit-feather-m0-radio-with-lora-radio-module/assembly>

⁵ <https://learn.adafruit.com/adafruit-feather-m0-radio-with-lora-radio-module/antenna-options>

3.1.3. Sparkfun Weather Shield

The Sparkfun Weather Shield does not come with the female header pins or the RJ11 6-Pin Connector included. As such it is necessary to order these components as well. Start by solder the female header pins in the Weather Sheild by following the suggested steps in the official Sparkfun guide⁶.

3.1.4. RJ11 connectors in Weather Shield

To acquire rain and wind data from the Weather Meters sensor kit, it is necessary to solder the two RJ11 connectors in the Sparkfun Weather Shield. Figure 4 shows the Sparkfun Weather Shield after solder the female header pins and the two RJ11 connectors.

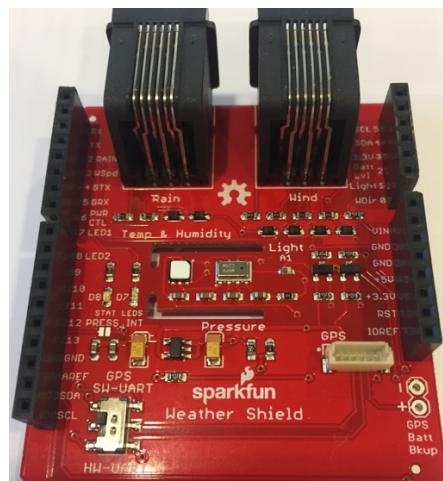


Figure 4 – Female header pins and RJ11 connectors in Weather Shield

3.1.5. Waziup Weather Station PCB

The Waziup Weather Station PCB, shown in Figure 5, is open-source, open-hardware, provides robustness and facilitate the integration of all the components to build the LoRa Weather Station with a plug-and-play approach.

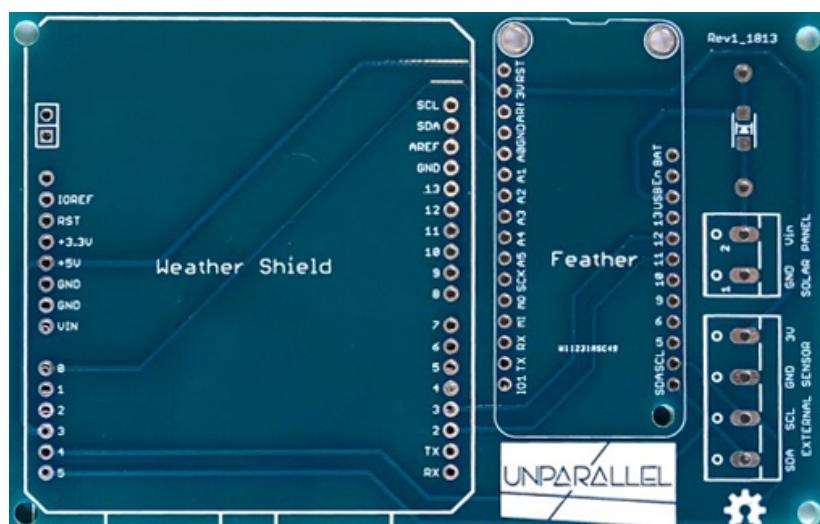


Figure 5 – Waziup Weather Station PCB

⁶ <https://learn.sparkfun.com/tutorials/arduino-shields/installing-headers-assembly>

The schematics and all necessary files to build the Waziup Weather Station PCB are hosted in the Waziup GitHub repository⁷ and a tutorial with all the step to ordering the PCB is available in Annex A – Order the Weather Station PCB.

After ordering and receiving the Waziup Weather Station PCB, as represented in Figure 6, it is necessary to solder the female header pins, three DG300-5.0 Connectors and a Schottky Diode in the PCB. The diode need to be solder with the cathode terminal (grey terminal) placed up as shown in the figure top right side.

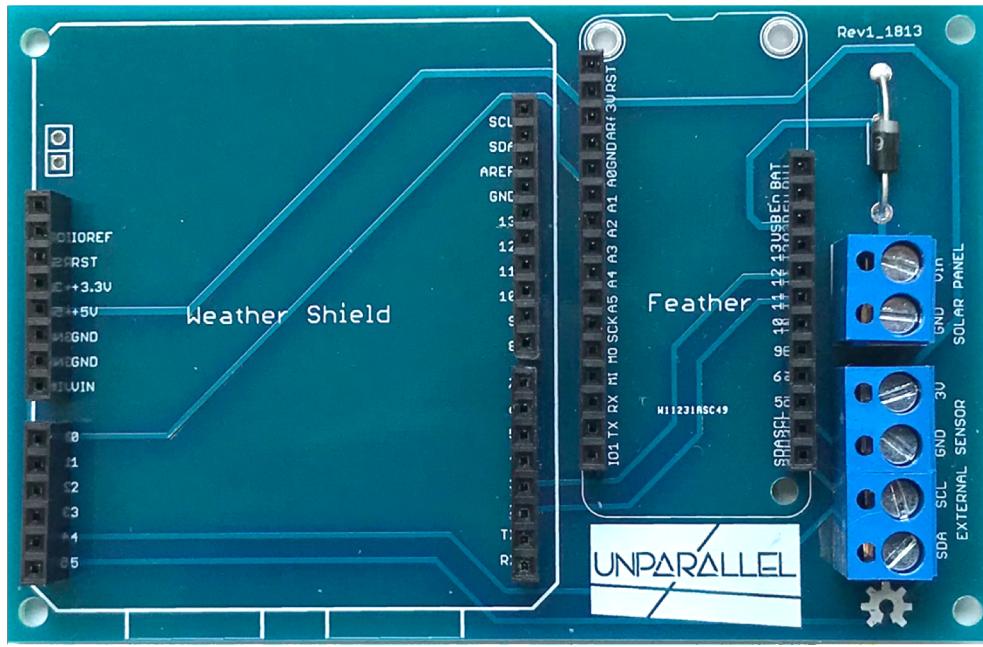


Figure 6 – Female header pins, DG300-5.0 connectors and diode in PCB

Note that the Adafruit Feather M0 comes with an integrated charging circuit which allows charging the battery using an external power source. Using a Schottky Diode allows that the current to go in the right direction when is using a Solar Panel to charge the battery.

If is not possible to use the Waziup Weather Station PCB, can be used a breadboard and cables to make the connections between the components. As such the following steps 3.2.2 to 3.2.5 must be replaced by the steps available in Annex B – Assembly without Waziup Weather Shield PCB.

3.2. Components Connection

3.2.1. Connect Antenna

Once soldered the “uFL SMT Antenna Connector”, can be connected the 868MHz Antenna in the Adafruit Feather M0. As such, it is necessary to screw the 868MHZ Antenna into the “RP-SMA to uFL Adapter Cable” to be able to connect to the “uFL SMT Antenna Connector” soldered in Adafruit Feather M0.

Note that there are also products in the market that have the 868MHz Antenna and the RP-SMA to uFL Adapter together.

⁷ <https://github.com/Waziup/WAZIUP-WeatherStation>



Figure 7 – Connect the 868MHz Antenna in Feather

It is necessary that the type of connection between the "uFL SMT Connector Adapter" and the Antenna must have the same type. If it does not happen, although it is possible to screw, will not be possible to make the communication.

Therefore, only "SMA Male" can be connected with "SMA Female" and "RP-SMA Male" with "RP-SMA Female". These different types of connectors are shown in Figure 8.

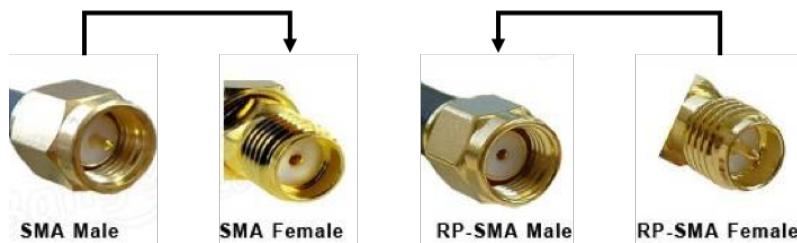


Figure 8 – Different SMA and RP-SMA connectors

3.2.2. Plug Weather Shield and Feather

After concluding the soldering task of all the components in the step 3.1 is possible to plug the Sparkfun Weather Sheild and the Adafruit Feather M0 in the respective places of the Waziup Weather Station PCB as shown in Figure 9. The Weather Shield already has built-in sensors that once plugged into the PCB established a connection with the Feather M0.

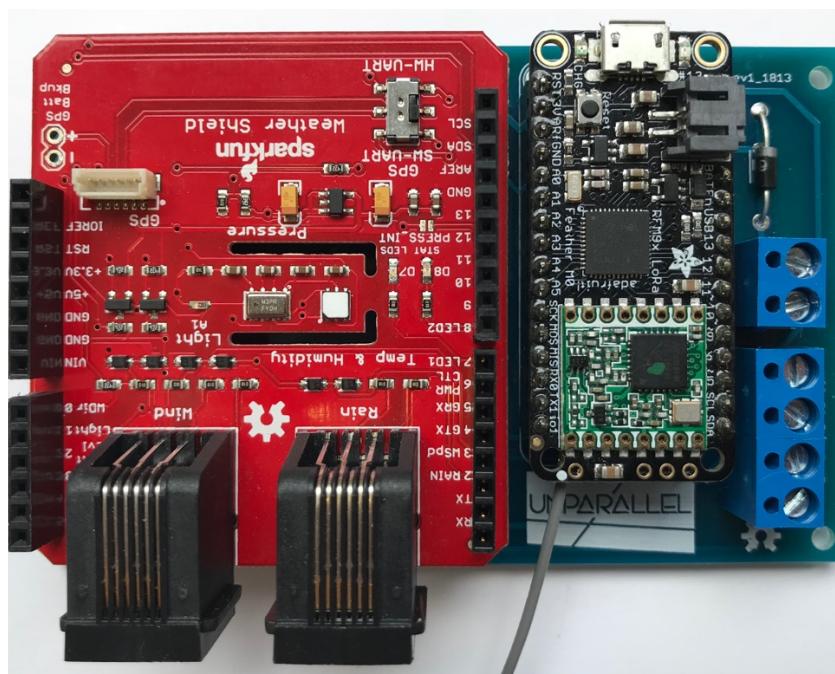


Figure 9 – Plug Weather Shield and Feather in PCB

3.2.3. Screw External Sensor

Figure 10 established the connection between the AM2315 Temperature and Humidity external sensor and the Waziup Weather Station PCB. As shown screw the external sensor cables in the respective PCB external sensor slots: red cable in “3V” slot, black cable in “GND” slot, white cable in “SCL” slot and the yellow cable in “SDA” slot.

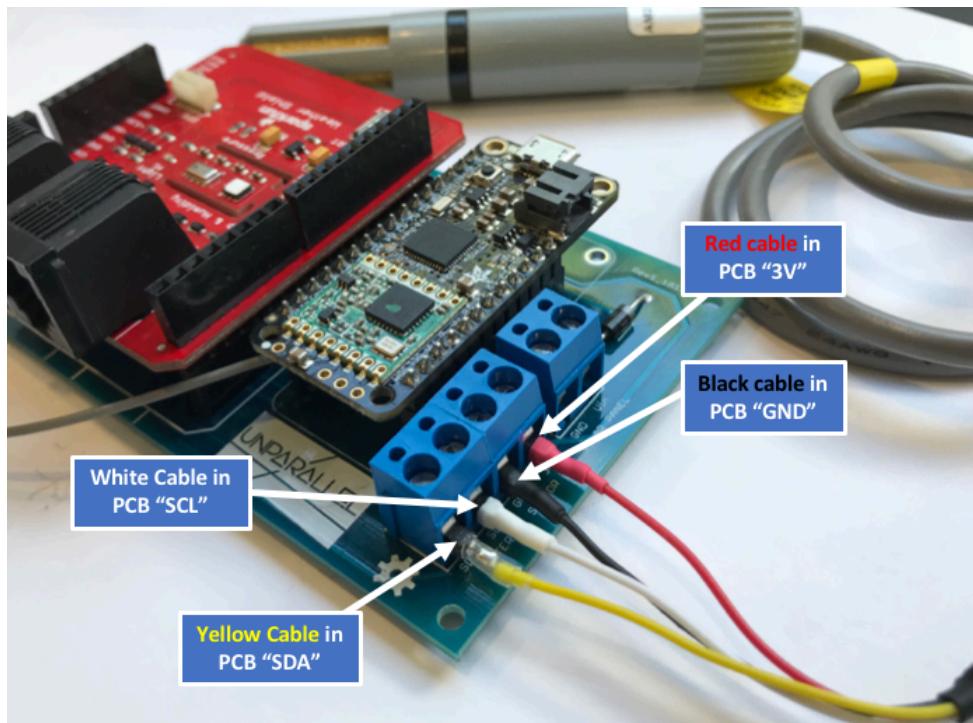


Figure 10 – Connect External Sensor in PCB

3.2.4. Screw Solar Panel

Figure 11 show the connection of the Solar Panel in the Waziup Weather Station PCB. As shown screw the Solar Panel cables in the respective PCB solar panel slots: red cable in “Vin” slot and the black cable in “GND” slot.

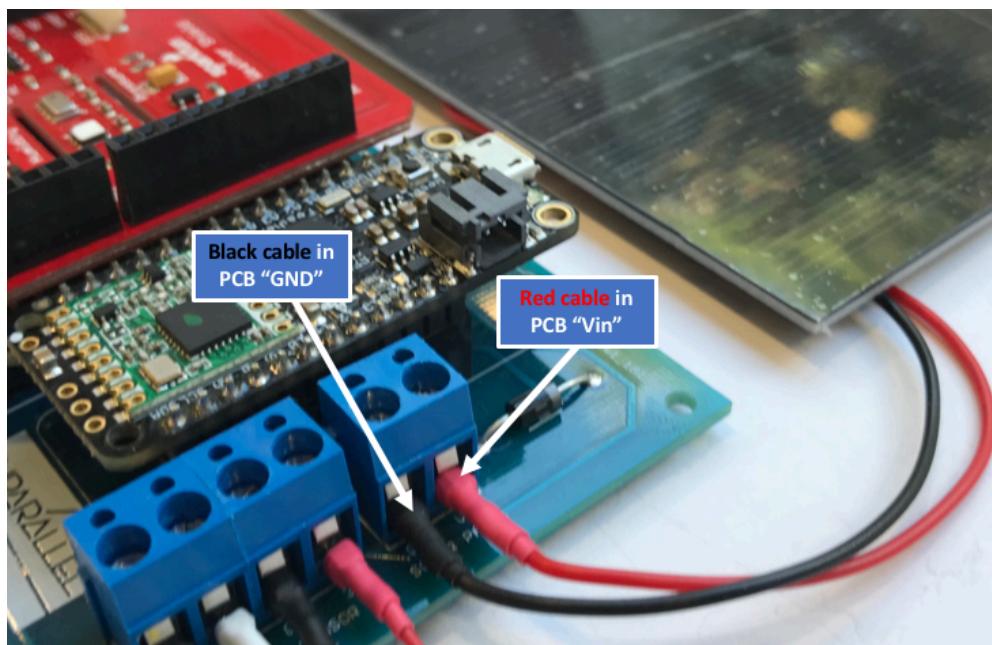


Figure 11 – Connect Solar Panel in PCB

3.2.5. Connect the Battery

To connect the battery in the Adafruit Feather M0 is only necessary to connect the battery 2-pin JST connector in Feather M0 JST slot as shown in Figure 12.

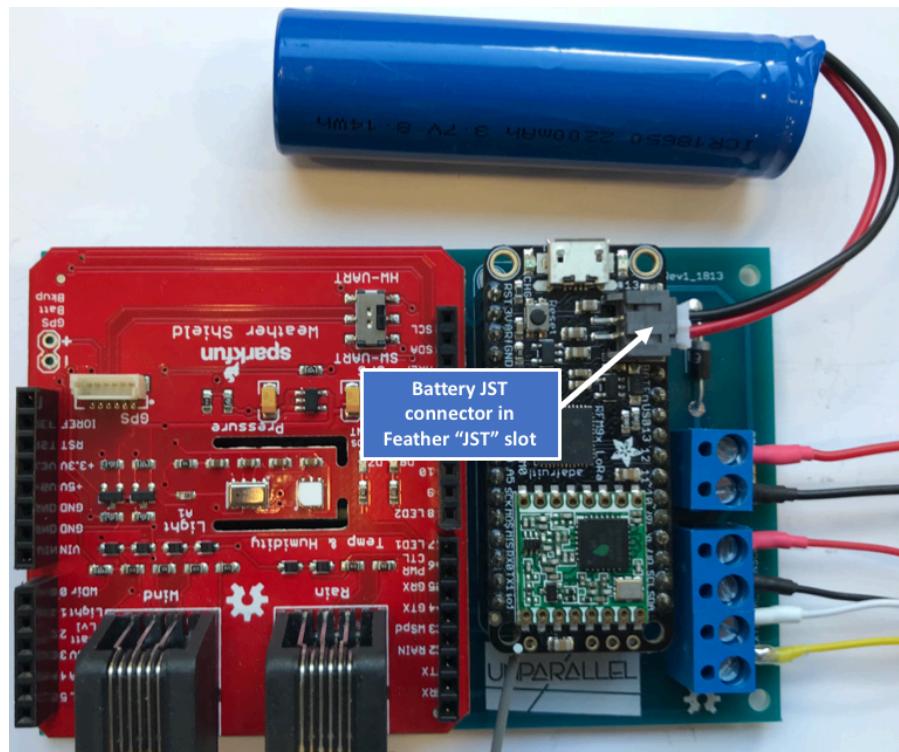


Figure 12 – Connect the Battery in Feather

3.2.6. Connect Weather Meters

To connect the Rain and Wind sensors from the Weather Meters in the Weather Shield it is necessary to pay attention and connect the Weather Meters RJ11 cables in the respective places as shown in Figure 13.

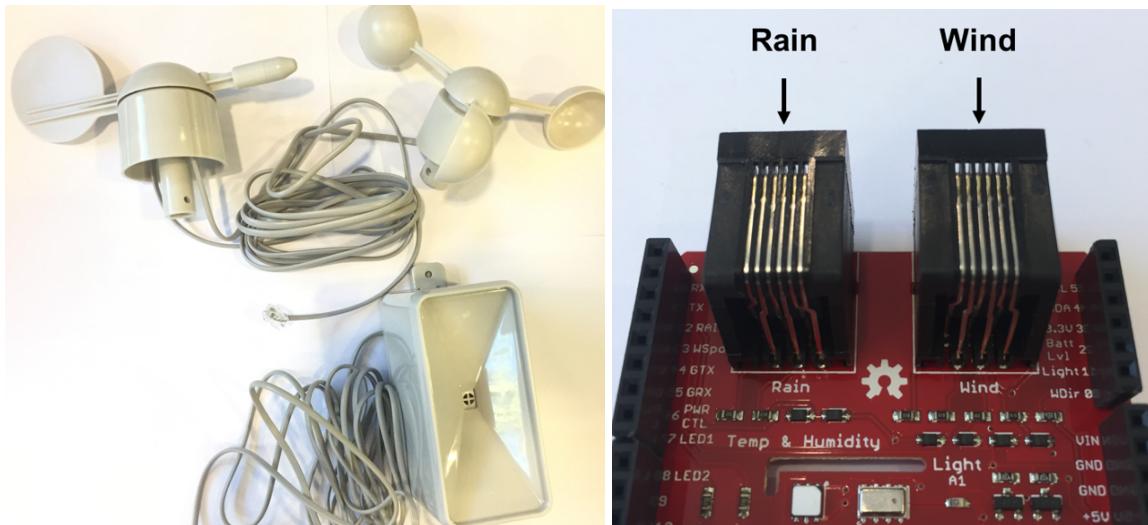


Figure 13 – Weather Meters and respective Rain and Wind connections

4. UPLOAD SOFTWARE

4.1. Download & Install Arduino IDE

First, it is necessary to download the Arduino IDE 1.6.6 or later. Go to the Arduino website⁸, select "Software" and choose the compatible version with the operating system that is being.

Once the download is complete, the Arduino IDE can be installed by following the suggested steps in the official operating system installation guide⁹.

4.2. Add Adafruit Boards to Arduino IDE

After completed the previous steps it is necessary go to "Arduino", "Preferences" and include the link for Adafruit boards in the "Additional Boards Manager URLs" as shown in Figure 14.

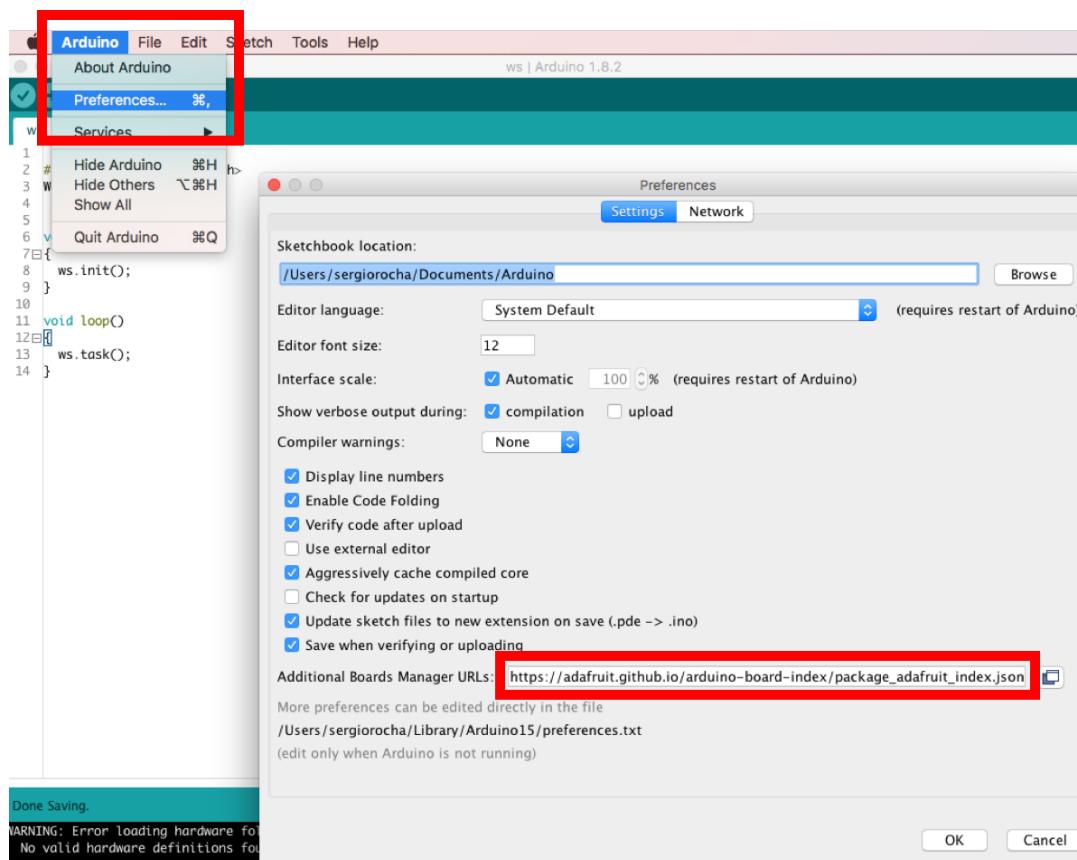


Figure 14 – Add Adafruit Boards to Arduino IDE.

To get the link for the Adafruit boards and conclude this task it is recommended to follow the steps in the official Adafruit guide¹⁰.

⁸ <https://www.arduino.cc/en/Main/Software>

⁹ <https://www.arduino.cc/en/Guide/HomePage>

¹⁰ <https://learn.adafruit.com/adafruit-feather-m0-radio-with-lora-radio-module/setup>

4.3. Install Adafruit Boards in Arduino IDE.

Once added the Adafruit Boards in the Arduino IDE, it is necessary go to “Tools”, “Board” and access the “Board Manager” to install the required Adafruit Board. To install correctly the Adafruit boards it is recommended to follow the steps in the official Adafruit guide for the Adafruit Feather M0¹¹ board.

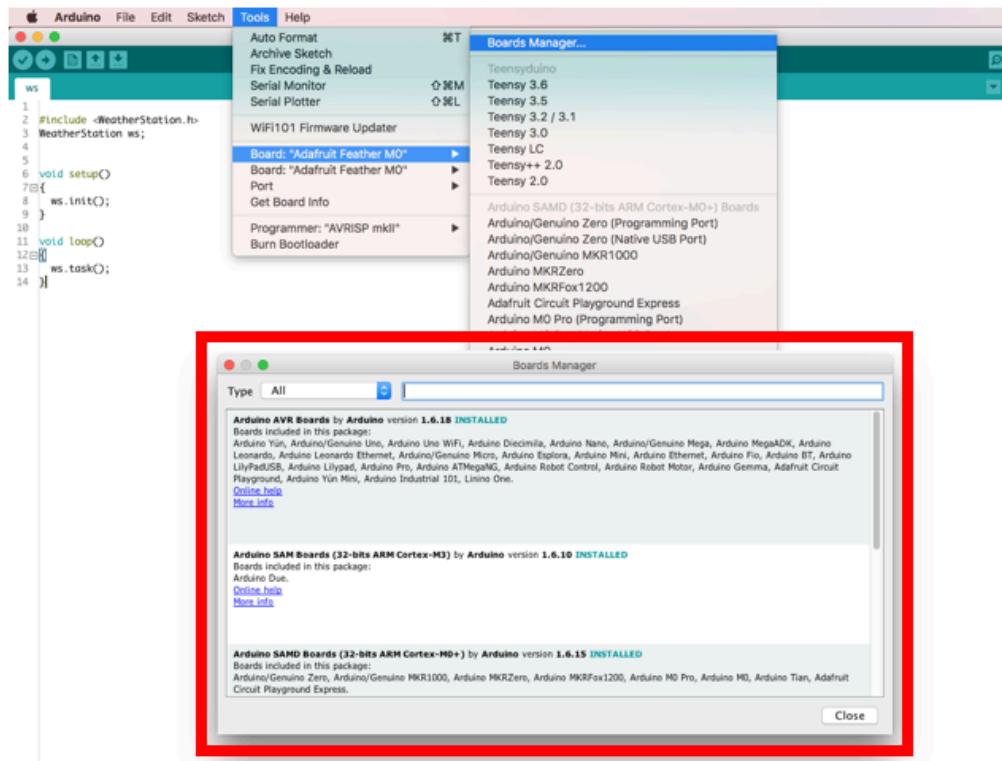


Figure 15 – Install Adafruit Boards in Arduino IDE

4.4. Download Weather Station library.

It is necessary to acquire the Weather Station library presents in the Waziup GitHub¹² that includes all necessary control functions and a set of other resources that allow the correct operation of the LoRa Weather Station. To do that click on “Clone or download” green button located in the right side from GitHub website and choose “Download Zip” option to download the “WAZIUP-WeatherStation-master.zip” file.

4.5. Install Weather Station library in Arduino IDE

Once completed the previous step is necessary include the downloaded “WAZIUP-WeatherStation-master.zip” file in the Arduino IDE. To do that go to “Sketch”, “Include Library” and click in the “Add ZIP Library” option. Will appear a window where need to be added the zip file.

¹¹ <https://learn.adafruit.com/adafruit-feather-m0-radio-with-lora-radio-module/using-with-arduino-ide>

¹² <https://github.com/Waziup/WAZIUP-WeatherStation>

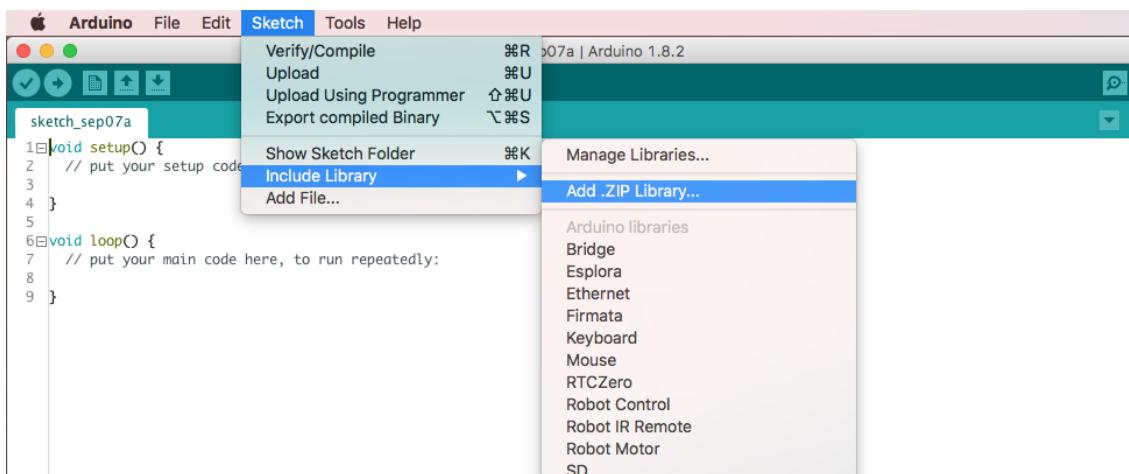


Figure 16 – Install Weather Station library by the "Add. ZIP Library"

4.6. Open Weather Station example code.

After conclude with success the previous step it is possible to open the Weather Station example code. To do that go to “File”, “Examples”, “Waziup Weather Station” and click in the “WaziupWeatherStation”.

This code, is the latest firmware tested from the LoRa Weather Station and include all the Weather Station configurations.

4.7. Choose Board and USB Port in Arduino IDE

After connect the micro-USB cable from the computer to the Feather, it is necessary choose the correct Adafruit Feather Board and the USB port in the Arduino IDE. To do that go to “Tools”, “Board” and click in the “Adafruit Feather M0” and go to Tools”, “Port” and click in the “Adafruit Feather M0” too.

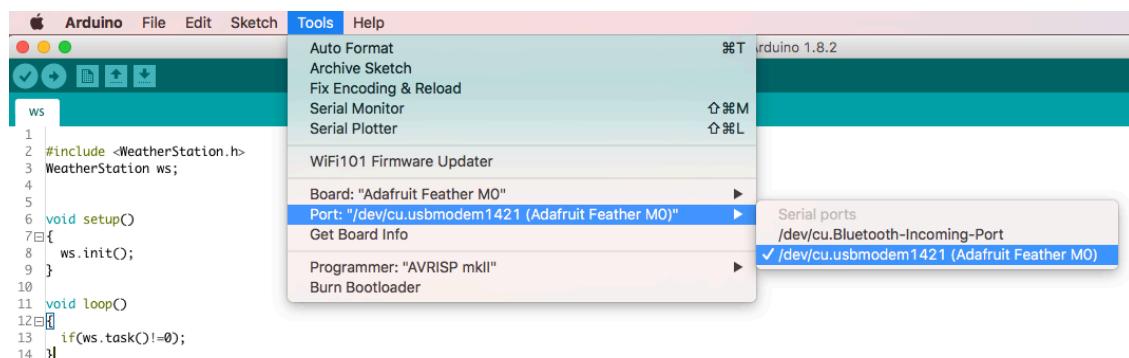


Figure 17 – Define the USB port

4.8. Upload the Weather Station software

The Weather Station already has some configuration parameters defined by default such as the period time in minutes between messages.

To upload the software in the Adafruit Feather M0 just need to click in the “Upload” button presented in the upper left side of the following Figure 18.

After concluding the upload with success, a message will appear in the lower left side. To open the Arduino Serial Monitor and visualize the LoRa Weather Station workflow click in upper right side button.

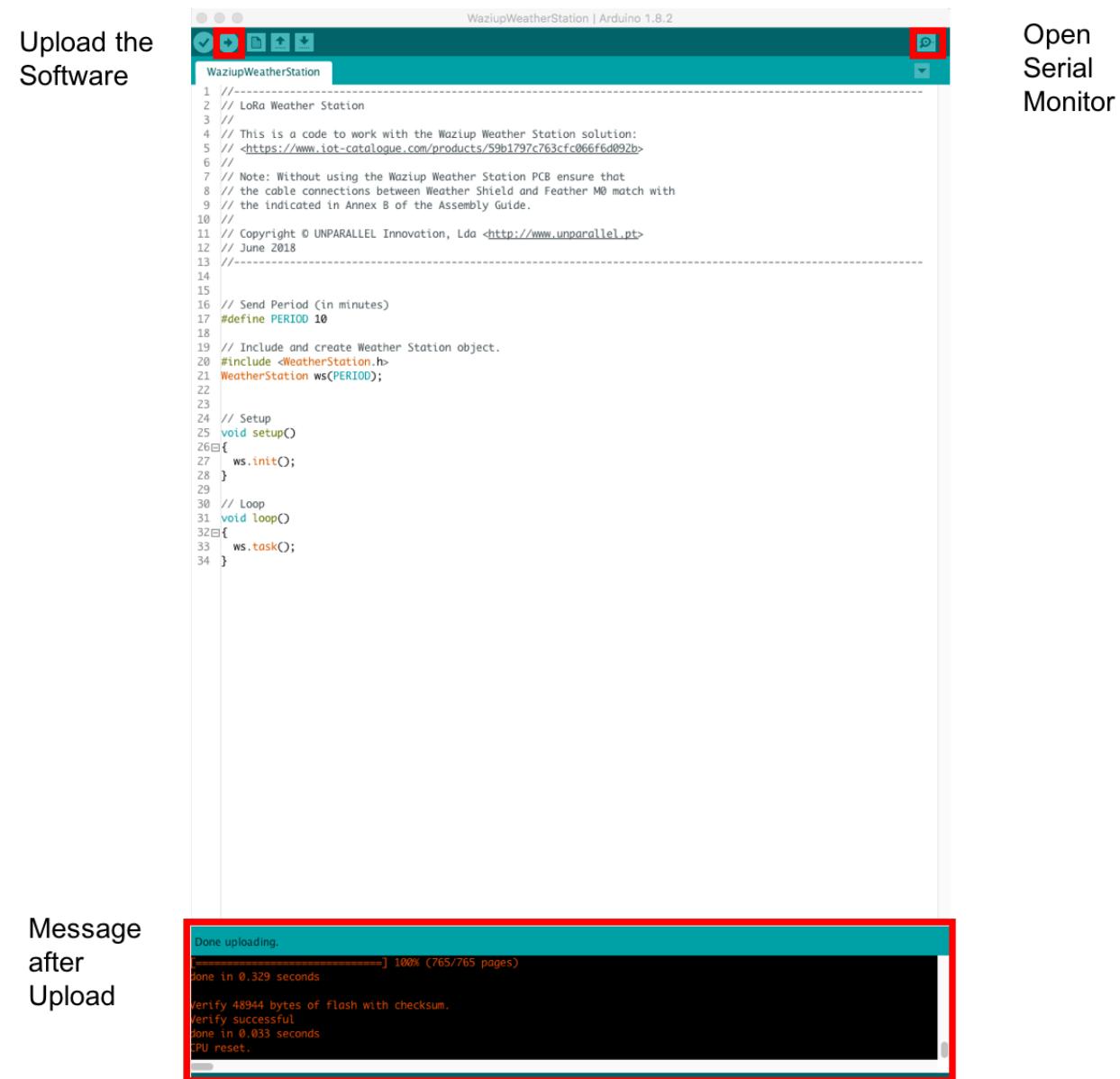


Figure 18 – Upload the software.

5. DEPLOYMENT WEATHER STATION

5.1. Assembly Weather Station in a Box

Once the previous steps have been completed, it will be necessary to place the assembly Weather Station inside a box to place easily in the desired location. Figure 19 show, as an example, the Weather Station in a box that not need to be the same. Pay attention to the material that the box is made. To place the Weather Station in locations under rain, it is convenient to use a waterproof box.

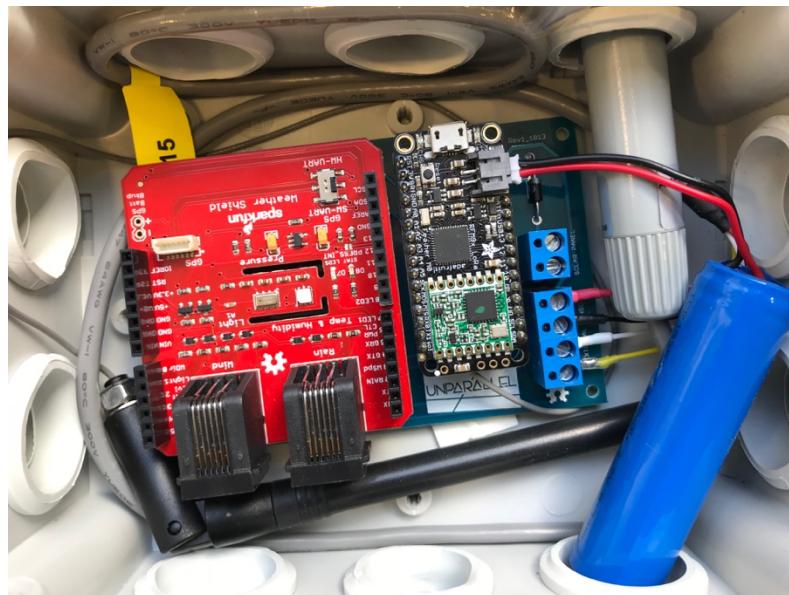


Figure 19 – Place Weather Station in a box

Place the components with some organization because will be easier in the future to change one component or access the microprocessor to re-upload the software. To place the components, use a contact material such as hot glue to ensures that the hardware is in the correct places and no cable connection is lost if, for some reason, a strong oscillation occurs in the box.

5.2. External Sensor outside the box

Make sure that the temperature and humidity external sensor is slightly out of the box, as shown in the box of Figure 20, and preferably in a shadow location without sun.



Figure 20 – Place external sensor outside the box

5.3. Assembly Weather Meters sensors

The Weather Meters come with material components, to allow their assembly in an auxiliary structure. These materials together allow to build a structure to easily place the sensors (rain, wind speed and wind direction).

Once assembled this structure can be placed in the desired location. To mount it is recommended to perform the suggested steps in the guide provided by SparkFun¹³.

5.4. Solar Panel outside the box

It is necessary to place the Solar Panel outside the box in a place where it is possible to guarantee the conditions of implementation. To realize and ensure a correct Solar Panel implementation it is recommended to consult the "Solar Panel Deployment" document that is available in folder "extra/documents" in the Waziup GitHub repository¹⁴

The hole created for the external sensor can be used to route the Solar Panel cables as well as the RJ11 Rain and Wind sensor cables.

Completed these steps the LoRa Weather Station shown in Figure 21 is ready to receive the measurements and send the information to the LoRa Gateway.

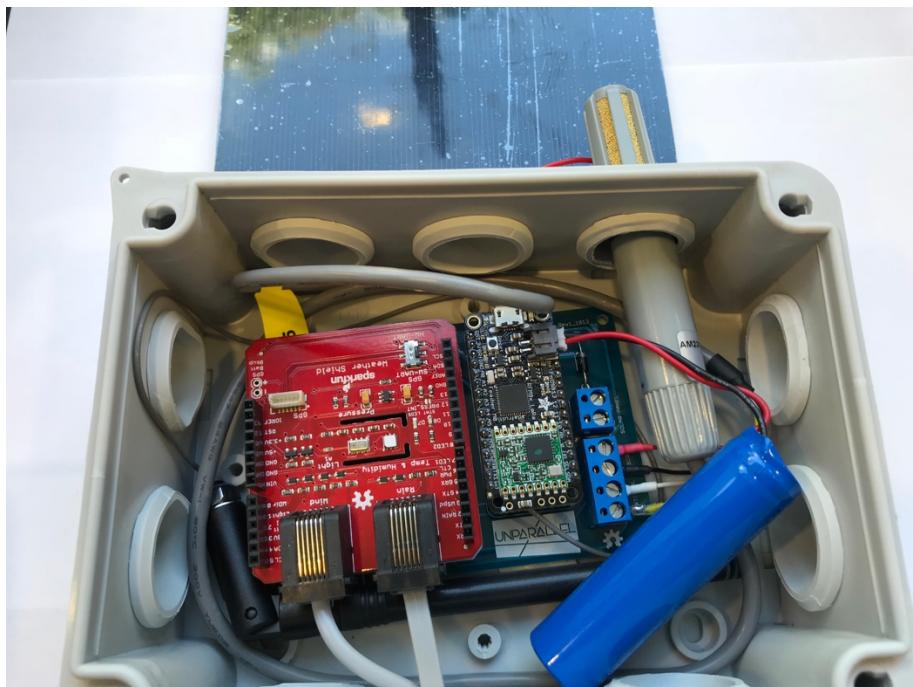


Figure 21 – LoRa Weather Station prototype

¹³ <https://learn.sparkfun.com/tutorials/weather-meter-hookup-guide>

¹⁴ <https://github.com/Waziup/WAZIUP-WeatherStation>

ANNEX A – ORDER THE WEATHER STATION PCB

This annex provides all the information on how to order the Waziup Weather Station PCB in the PCBway¹⁵ manufacture. The first step is to access and register in PCBWay website. Sign in with a valid account by clicking the respective button on the top right side. The Weather Station PCB has two order options.

The first option is by using the share project link (easy and fast method) and the second option allow the customization of all the PCB specifications (typical method).

1st Option – Order by share project link

a) PCB project link

The PCB can be ordering easily by accessing the Weather Station PCB project link¹⁶ in the PCBWay website and click “Add to cart” button.

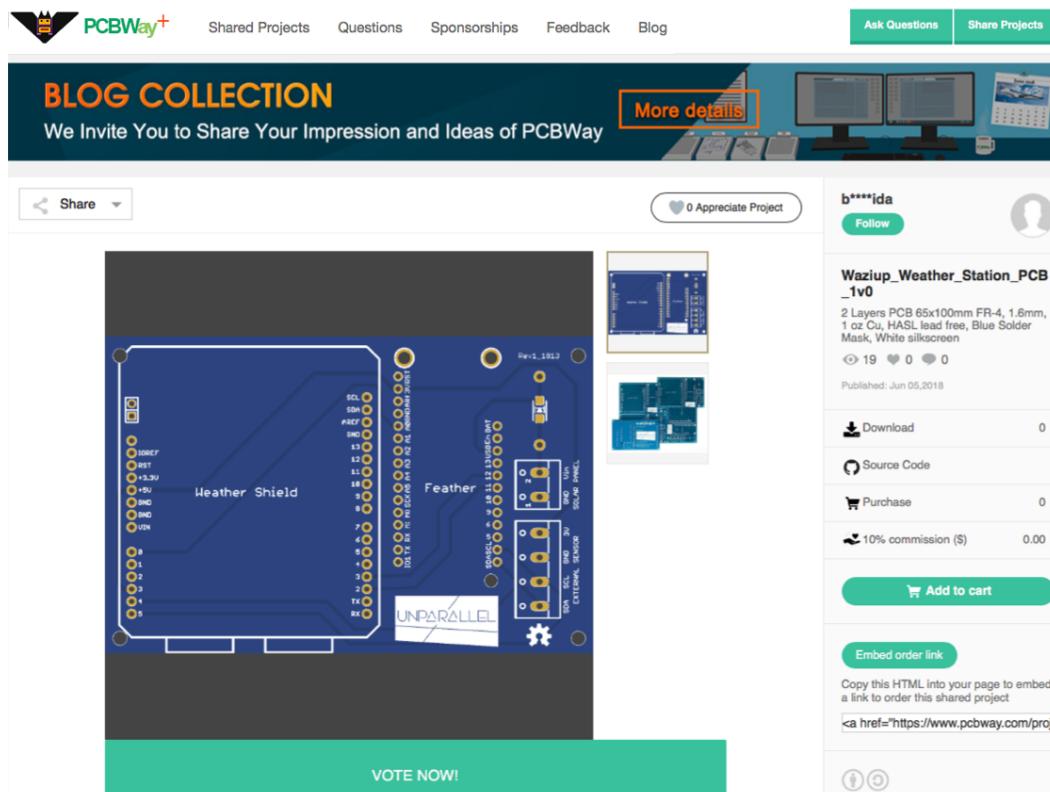


Figure 22 – Weather Station PCB share project link.

b) Minor specifications

Ordering through this option the PCB comes with pre-set specifications and only can be modified some such as “Surface Finish”, Finished Copper”, “Solder Mask”, “Silkscreen”, “Quantity” and “Build Time” as shown in Figure 23. Click in “Submit” button to order the PCB and wait for the PCBway validation process.

¹⁵ <https://www.pcbway.com>

¹⁶ https://www.pcbway.com/project/shareproject/Weather_Station_PCB_1v0.html

*Size and Layers need to be “100x65mm” and “2 Layers” respectively

Add to cart X

Board Type :	Single PCB	GerberFile :	W11231ASC5...ion_PCB_1v0.zip
Size :	100 x 65 mm	Material :	FR-4 TG130
Layers :	2 layers	Thickness :	1.6 mm
Min Track/Spacing :	6/6mil	Min Hole Size :	0.3 mm
Gold fingers :	No	Via Process :	Tenting vias
Surface Finish :	HASL lead free	Finished Copper :	1 oz Cu
Solder Mask :	Blue	Silkscreen :	White
Quantity :	<input type="text" value="5"/>	Build Time :	(3-4 days)
Additional Options:			
Manufacturing :	<input type="text"/>		
Total: US \$19			
Submit			

Figure 23 – Weather Station PCB pre-set specifications.

2nd Option - Customized Order

a) PCB Specifications Selection

After accessing the PCBway website click on “PCB Instant Quote”, select “Online Quote”, “PCB” and select the required specifications. Table 1 and Figure 22 show the respectively pre-set specifications (used in the order by the share project link). These specifications can be modified however the “size” (100x65mm) and “layers” (2 Layers) need to remain the specified for the ordering be accepted in the PCBWay validation process.

Table 1 – PCB pre-set specifications

PCB Specifications	Value/Option
Board type	Single pieces
Different Design in Panel	1
Size*	100x65mm
Layers*	2 Layers
Material	Normal FR-4 Board
FR4-TG	TG 130-140
Thickness	1.6
Min Track/Spacing	6/6mil

Min Hole Size	0.3mm
Solder Mask	Blue
Silkscreen	White
Gold fingers	No
Surface Finish	HASL lead free
Via Process	Tenting vias
Finished Copper	1 oz Cu

PCB Specification Selection

Board type: Single pieces Panel by Customer Panel by PCBWay

Different Design in Panel: 1 e.g.

* Size (single): 100 X 65 mm inch'↔mm

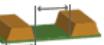
* Quantity (single): 10 pcs

Layers: 1 Layer 2 Layers 4 Layers 6 Layers 8 Layers 10 Layers 12 Layers 14 Layers

Material: Normal FR-4 Board Aluminum Board Rigid-Flex Board

FR4-TG: TG 130-140 TG 150-160 TG 170-180

Thickness: 0.4 0.6 0.8 1.0 1.2 1.6 2.0 2.4 * Unit: mm 

Min Track/Spacing: 4/4mil 5/5mil 6/6mil 8/8mil ↑ 

Min Hole Size: 0.2mm 0.25mm 0.3mm ↑ No Drill 

Solder Mask: Green Red Yellow Blue White Black
 Purple Matte black Matte green None

Silkscreen: White Black None

Gold fingers: Yes No

Surface Finish: HASL with lead HASL lead free Immersion gold OSP Hard Gold None

Via Process: Tenting vias Plugged vias Vias not covered

*For Gerber files, this choice is useless. It will be made according to files as default.

Finished Copper: 1 oz Cu 2 oz Cu 3 oz Cu 4 oz Cu 

Figure 24 – PCB Specifications Selection

Note that some changes in the specifications when customizing the order can have a significant impact in the final price.

b) Calculate price

After select the required specifications click on the “Calculate” button, select the shipping type and country in order to calculate the order price and click on “Add to Cart” button.

The screenshot shows the "Pricing And Build Time" section of a PCB ordering interface. It includes a "PCB Price" table and a "Price Comparison Matrix". The "PCB Price" table has columns for "Build Time", "Qty", and "Total". It lists two options: "2-3 days" (checked) with 5 units at \$19, and "Express 24hours" with 5 units at \$43. The "Price Comparison Matrix" is currently empty. Below the table, a note says "Final price is subject to our review." A dropdown menu for "Shipping Cost" shows "DHL" selected. Another dropdown menu shows "PORTUGAL" selected. At the bottom, there is a summary row for DHL shipping to Portugal: "DHL" icon, "3-5 Days", "wt : 0.114 kg", and "\$25".

Figure 25 – Calculate order price

c) Upload Gerber files

Select the “gerber files” option and click on “Add Gerber file” to upload the Waziup Weather Station PCB Gerber files that are available on the Waziup Weather Station Github¹⁷ repository and click on the “Submit Order Now”. Note that the files need to be uploaded together in a zip/rar file.

The screenshot shows the "Upload File" dialog box. It has a header "Upload File" and a sub-header "Attach Your Gerber Files" with a note that PCBWay will never disclose your PCB files to any third party! Below this, it displays the PCB Order Number: W11231ASC56 (100 mm X 65 mm), Layers: 2, Thickness: 1.6 mm, Finished Copper: 1 oz Cu, Surface Finish: HASL lead free, Solder Mask: Blue, Silk Screen: White. There are three radio button options: "gerber files(RS-274-X)" (selected), "DXP (.pcb/.pcbdoc)", and "Others (eagle.brd/.cam etc)". A blue button "+ Add Gerber File" is visible. Below the file input area, it says ".rar or .zip Maximum 10M(.pcb .pcbdoc .cam .brd and gerber files)". A note at the bottom says "Uploading in failure? You can skip and email your PCB files to service07@pcboway.com". At the bottom, there are buttons for "Submit Files" (with a 10mins - 1 hours timer), "Complete Review (Except SMT or special order)", "Submit Order Now" (in a green button), "skip", and "Eagle(brd) => Gerber file" (with a right-pointing arrow).

Figure 26 – Upload Gerber files

¹⁷ https://github.com/Waziup/WAZIUP-WeatherStation/tree/master/Proto_Feather_with_Weather

d) Waiting validation process

After submitting the order, PCBway will check all files to review the design and to be sure that the PCB can be fabricated. If the validation process is accepted can be proceed the check out by doing the payment and wait for the order.



Figure 27 – Set of received Waziup Weather Station PCB

ANNEX B – ASSEMBLY WITHOUT WAZIUP WEATHER SHIELD PCB

If the Waziup Weather Station PCB is not being used, it is recommended to use a breadboard and cables with different colours when connect the circuits between the components.

e) Power the Weather Shield

To power the Weather Shield, use the Feather “3V” pin and make sure to connect in the Weather Shield “3.3V” pin and not in the “+3.3V”. Also connect the Feather “3V” pin in the Weather Shield “+5V” pin.

It is also necessary connect the Feather “GND” pin to the Weather Shield “GND” pin. Table 2 and Figure 28 respectively presents and shows the power connection using the breadboard as a bus between the Adafruit Feather M0 and the Sparkfun Weather Shield.

Table 2 – Pin Connection to power the Weather Shield

Adafruit Feather	Sparkfun Weather Shield
GND	GND
3V	(+5V) and (3.3V)

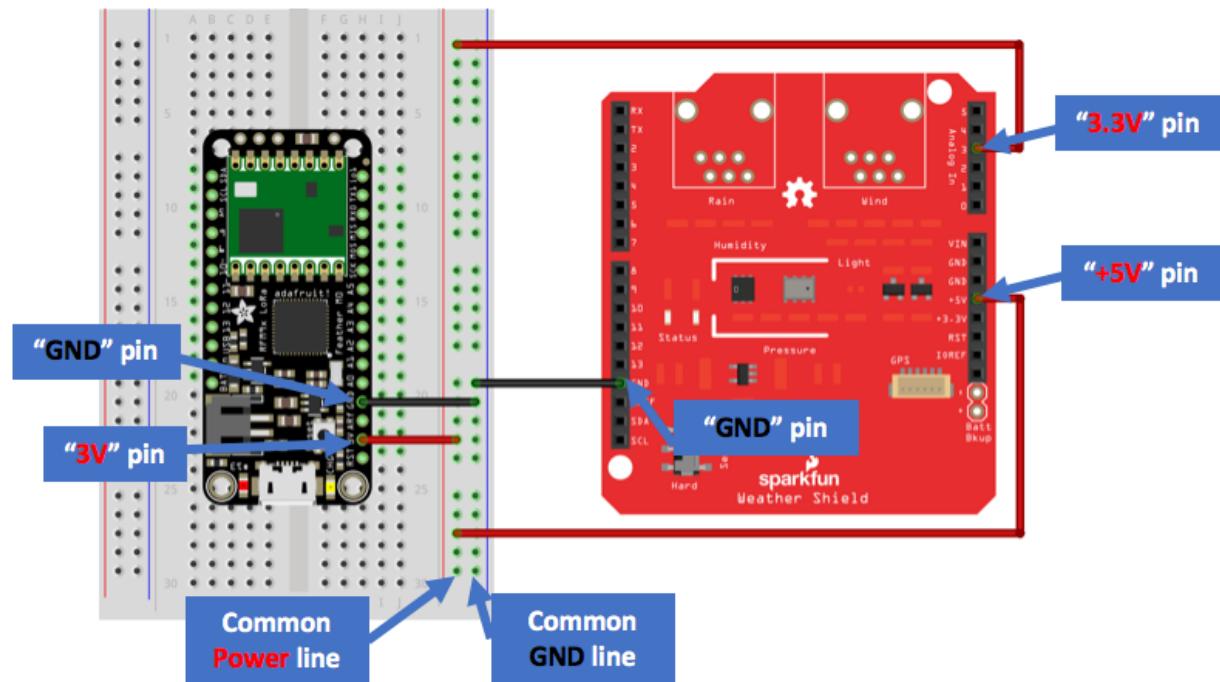


Figure 28 – Weather Shield power connection

f) Connect Weather Shield sensors

The Sparkfun Weather Shield already has built-in sensors that need to be connected to the Adafruit Feather M0. These connections are established in Table 3 and is shown in Figure 29.

First it is necessary connect the Feather "SDA" pin to the Weather Shield "SDA (4)" pin and the Feather "SCL" pin to the Weather Shield "SCL (5)" pin.

The Wind Direction connection is shown through the green cable that connects the Feather "A0" pin to the Weather Shield "WDir (0)" pin.

The Rain pin must be connected as shown in figure through the orange cable by connecting the Feather "11" pin to the Weather Shield "RAIN" pin.

To the Wind Speed, connect the Feather "12" pin to the Weather Shield "WSpd (3)" as shown through the blue cable.

Table 3 – Weather Shield internal sensors pin connection

Adafruit Feather	Sparkfun Weather Shield
SDA	SDA(4)
SCL (white cable)	SCL(5) (white cable)
A0	WDir (0)
11	RAIN (2)
12	WSpd (3)

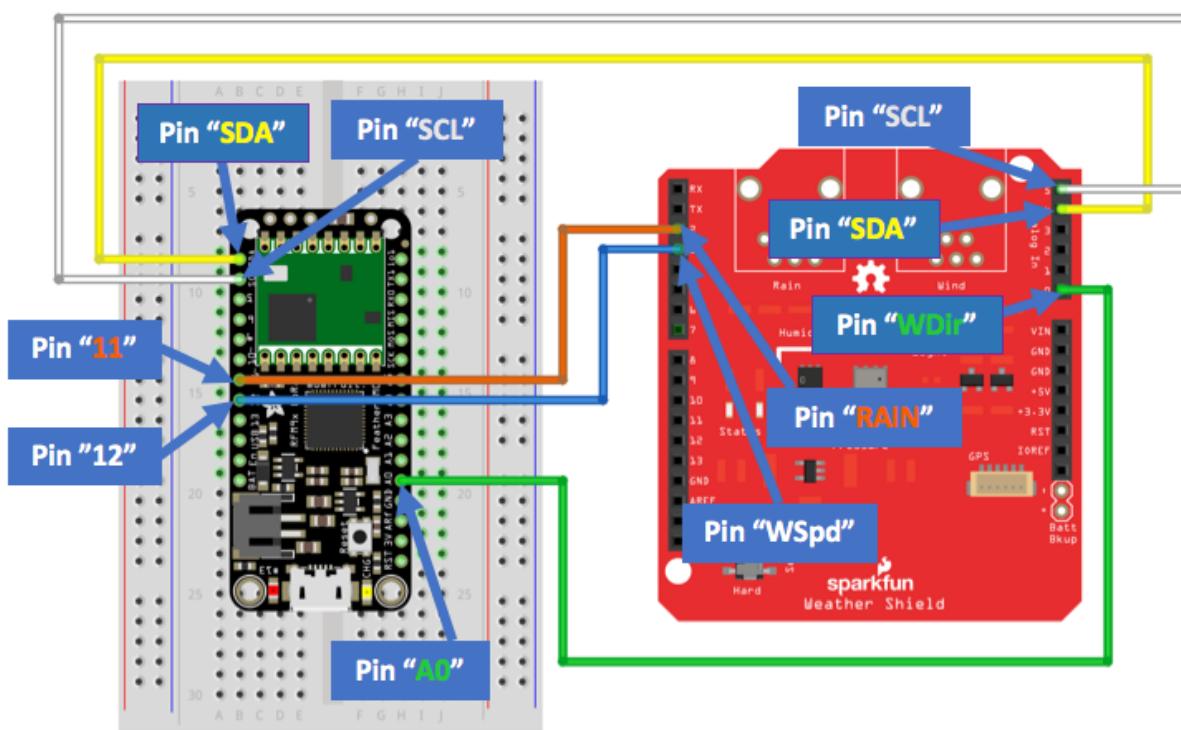


Figure 29 – Weather Shield internal sensors pin connection

g) Connect External sensor

Table 4 established the connection between the Adafruit Feather M0, the AM2315 Temperature and Humidity external sensor and the Sparkfun Weather Shield. The Figure 30 presents the Table 3 established connection.

The Weather Shield has one more set of "SDA" and "SCL" pins (the last two pins on the left side) that can be used to connect the external sensor yellow cable to the Weather Shield "SDA" pin and the external sensor white cable to the Weather Shield "SCL" pin.

Also connect the external sensor red cable "VCC" to the common power of the breadboard and the external sensor black cable "GND" to the common "GND" of the breadboard.

Table 4 – Pin Connection between Feather, External sensor and Weather Shield

Breadboard	Sparkfun Weather Shield	AM2315 sensor
GND	-	Black cable
3V	-	Red cable
-	SDA	Yellow cable
-	SCL	White cable

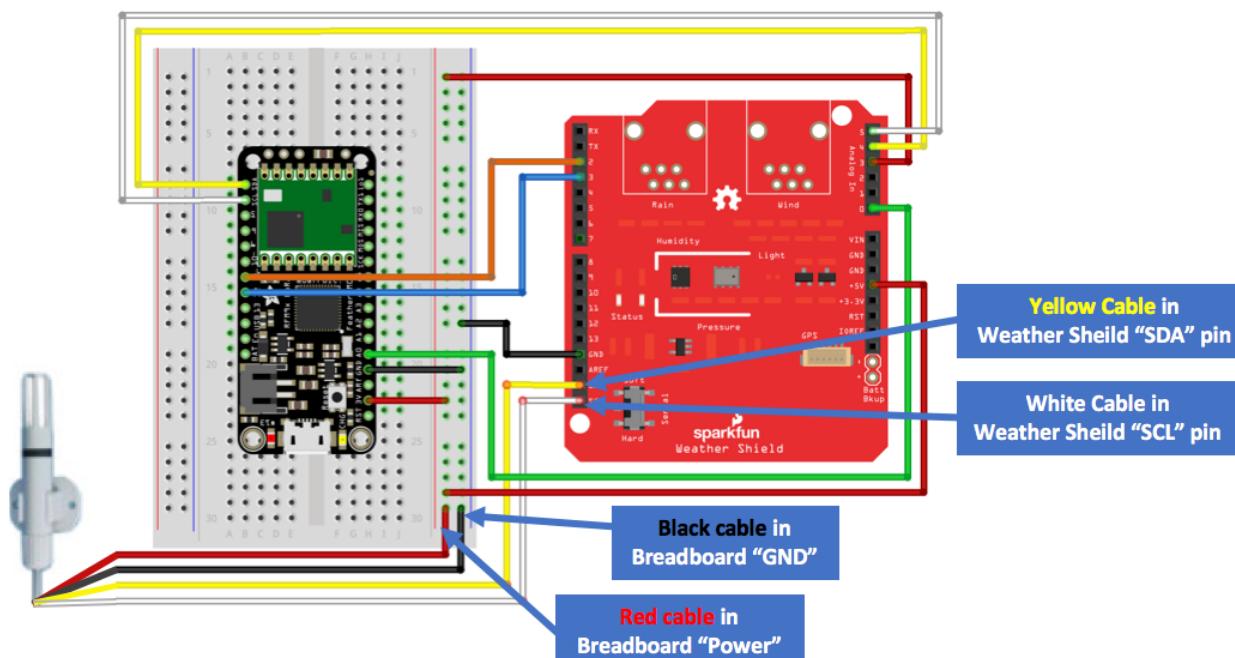


Figure 30 – Pin Connection between Feather, External sensor and Weather Shield

h) Connect the Battery

To connect the battery in the Adafruit Feather M0 is only necessary to connect the battery 2-pin JST connector in Feather M0 JST slot as shown in Figure 31.

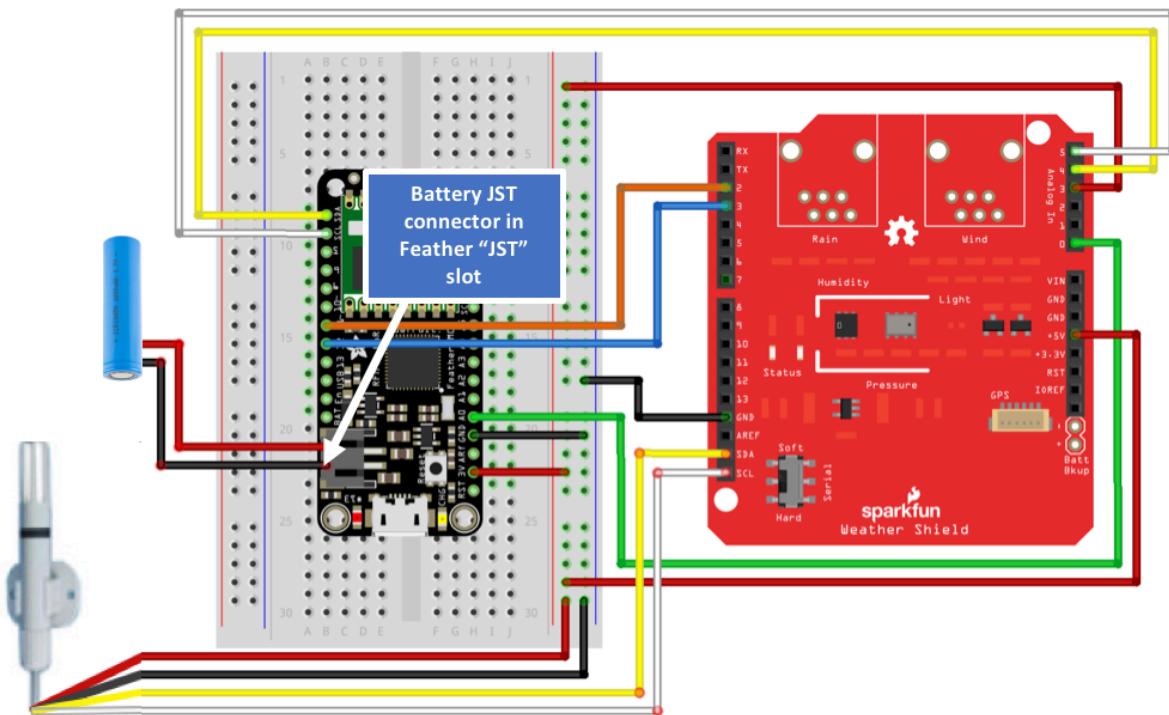


Figure 31 – Connect the Battery in Feather with cables

i) Connect the Solar Panel

The Adafruit Feather M0 comes with an integrated charging circuit which allows to charge the battery using an external power source. To use a Solar Panel to charge the battery it is also necessary to use a Schottky Diode to allows that the current to go in the right direction and not to the Solar Panel.

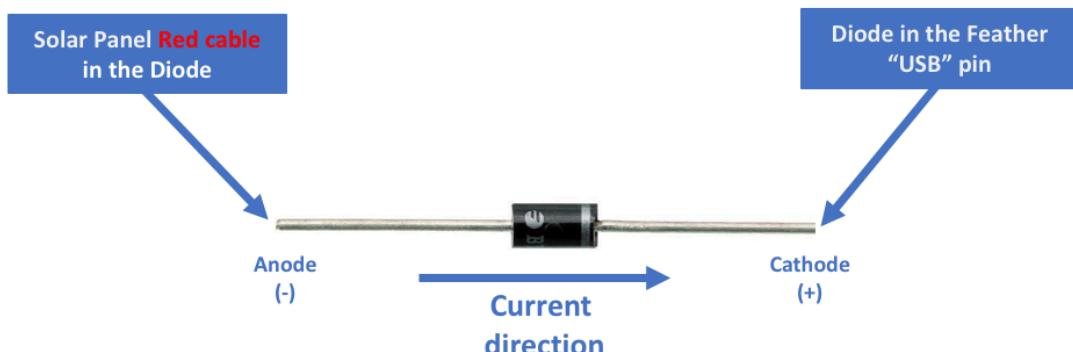


Figure 32 – Correct Diode connection

As represented in Figure 33 connect the Solar Panel red cable to the Schottky diode (in Anode terminal) and from the diode (Cathode terminal) to the Feather "USB" and also connect the Solar Panel black cable "GND" to the common breadboard "GND".

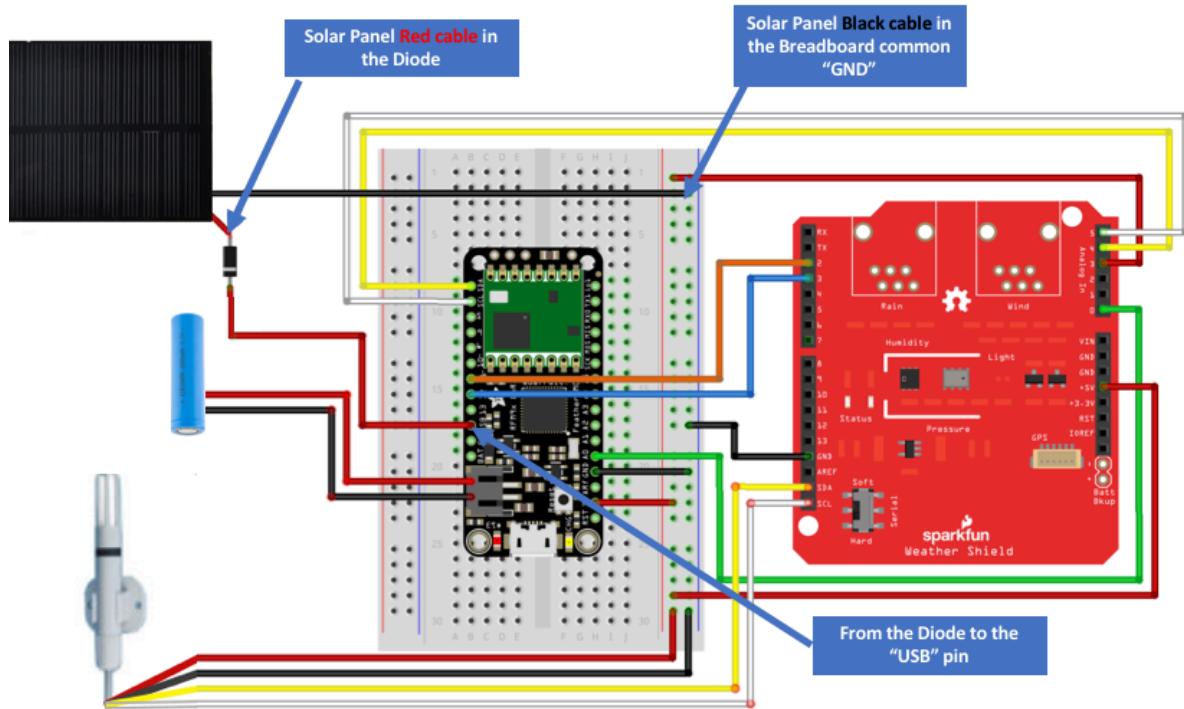


Figure 33 – Solar Panel connection

Continue the LoRa Weather Station assembly by connecting the Weather Meters as mentioned in step 3.2.6.

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