6/16/2024

Wireless Weather Station v1

Build Document

Vrishab Kakade

TABLE OF CONTENTS

DOCUMENT CONTROL

Date	Version	Change
June 16, 2024	1	Initial build - The breadboard version that is used for a proof of concept

INTRODUCTION

Links for this project:

vrishabkakade/wireless_weatherstation_v1: This repository contains all the code for the weather station (github.com)

Instructables page

This file

PROJECT OUTLINE:

This project aims to construct a wireless personalized weather station capable of measuring various atmospheric and environmental parameters. The station will monitor and display the following:

1. Temperature
2. Humidity
3. Barometric Pressure
4. Wind Speed
5. Wind Direction
6. Rainfall
7. Dew Point

The project is inspired by the Raspberry Pi Foundation's "Build your own weather station". However, **this project will make the sender wireless and integrate the sender and receiver hardware with WeeWX: open source weather software.**

I have previously deployed the Raspberry Pi's weather station following their instructions and the live real-time data can be viewed at Betta Forecast. I have also integrated RPi weather station with Weewx.

Version 1 of the wireless weather station is a proof of concept that will be executed on a breadboard and indoors. This project aims to understand how the architecture works before going to more complex prototype builds.

Subsequent versions will build a prototype that will be deployed on the field.

This project has the potential to provide valuable insights into local weather conditions and environmental factors. It can be used for various applications such as personal weather forecasting, gardening, and scientific research. By making the sender wireless, the station can be placed in remote locations or areas with difficult access to power outlets. The integration with WeeWX allows for easy data storage, visualization, and sharing.

To ensure the success of this project, careful planning and execution are necessary. This includes selecting the appropriate sensors, designing the wireless communication system, and integrating the hardware with WeeWX. The project also involves data analysis and visualization to make the weather data meaningful and accessible.

Overall, this project is an exciting opportunity to create a customized weather station that meets specific needs and preferences. It combines hardware, software, and data analysis to provide a comprehensive understanding of local weather conditions.

The data gathered from the deployed sensors can be utilized in various ways. One exciting application is feeding the data into advanced AI models like Google DeepMind's GraphCast.

GraphCast is a powerful AI system that can perform graph-based forecasting. By leveraging GraphCast, we can generate accurate and granular forecasts of local weather conditions. This has the potential to revolutionize weather forecasting, providing real-time and hyper-local predictions that can be tailored to specific geographic areas.

Other potential open-source application that can use this data is Microsoft's FarmVibes.AI: Multi-Modal GeoSpatial ML Models for Agriculture and Sustainability

The integration of sensor data with AI models like GraphCast opens up a wide range of possibilities. Here are some examples of how this combination can enhance weather forecasting:

1. **Improved Accuracy:** By incorporating real-time sensor data, AI models can learn from the latest observations and make more accurate predictions. This can help mitigate the limitations of traditional weather forecasting models, which often rely on historical data and may not capture sudden changes in weather patterns.

2. **Granular Forecasting:** The combination of sensor data and AI enables the generation of highly granular forecasts. Instead of relying on broad regional forecasts, users can access localized predictions for specific neighborhoods or even streets. This level of detail is particularly valuable for applications such as agriculture, transportation, and disaster management.

3. **Real-Time Monitoring:** With the continuous flow of data from the sensors, AI models can perform real-time monitoring of weather conditions. This allows for the detection of rapidly changing weather patterns, such as thunderstorms or sudden wind shifts, providing timely alerts and warnings to affected communities.

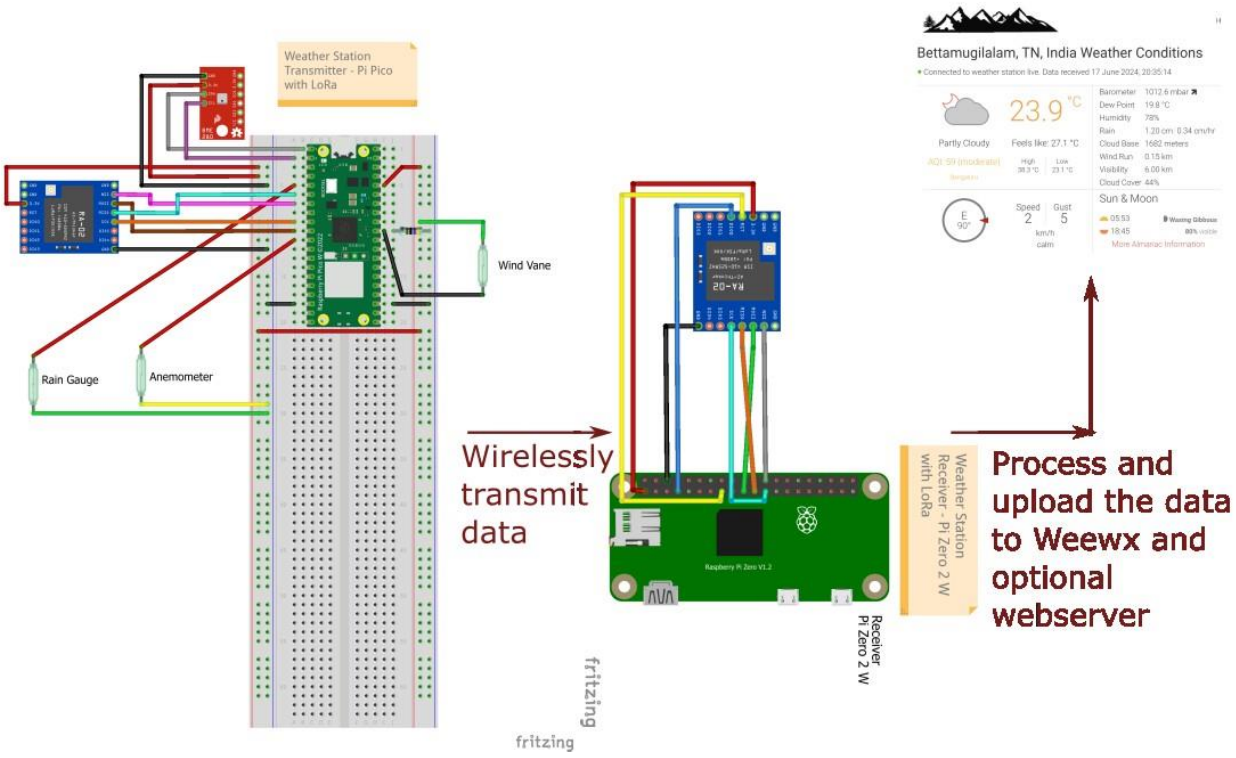
4. **Climate Analysis:** The long-term collection of sensor data can be used for climate analysis. By studying the historical data, scientists and researchers can gain insights into climate patterns, identify trends, and assess the impact of climate change on local weather conditions.

5. **Smart City Applications:** In smart cities, real-time weather data can be integrated with urban infrastructure to improve traffic management, energy efficiency, and public safety. For example, data from weather sensors can be used to adjust traffic signals in response to changing weather conditions, reducing congestion and improving overall mobility.

By leveraging the power of open-source and advanced AI models, this project has the potential to transform weather forecasting, offering more accurate, granular, and timely predictions that can benefit individuals, communities, and organizations worldwide.

👨‍🔧 ARCHITECTURE

Wireless Weather Station Architecture



🤔 FUTURE ENHANCEMENTS:

1. Solar powered transmitter
2. Air Quality Index
3. UV Index
4. Light Intensity
5. Soil Moisture

🖍️ DATA ACCESSIBILITY:

The system will publish real-time weather data to one or many websites, allowing remote monitoring of current weather conditions.

🎯 MOTIVATION:

Accurate weather forecasting is crucial, particularly for farmers who rely on timely information for agricultural decision-making. Existing forecasts often cover broad regions and may not accurately reflect local conditions. By gathering localized weather data, farmers can make informed decisions regarding crop protection, fertilization, and irrigation.

💉 IMPLEMENTATION:

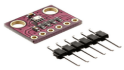
💻 **HARDWARE SETUP:** The BME280, Wind Vane, Anemometer, Rain Gauge and LoRa transmitter are connected to Raspberry Pi Pico. The Pico will transmit the data wirelessly to a LoRa-connected Raspberry Pi (in my case I use Pi Zero 2 W, but any version of Pi can be used) which will act as a receiver and process the data received.

🟫 **SOFTWARE SETUP:** Data storage will be managed using the Weewx platform, while data visualisation will be achieved through customisable skins.

As for the weather predictions goes – the most important is the rainfall data. Ideally, I should be able to pass the captured data to Google's Graphcast or any other AI and get a weather forecast for my specific location. The problem with weather forecasts today is that it is given for a much wider region and they might not necessarily apply to our location. For example, in the coffee estates, it would have rained a few kilometres away, but not in that estate. More accurate weather predictions for a particular region will be able to help farmers determine things like when to spray their plants, manure them and irrigate them. Regarding weather forecasts, the rainfall data is of utmost importance. Ideally, the captured data should be compatible with AI platforms like Google's Graphcast, enabling us to obtain weather forecasts specific to our location. The current challenge with weather forecasts is that they are often provided for broader regions, which may not accurately represent local conditions. In agricultural settings, for instance, rainfall can vary significantly within a few kilometers, impacting farming activities such as spraying plants, applying manure, and irrigation. Accurate and localized weather predictions for a particular region can assist farmers in making informed decisions about their crops.

💻 HARDWARE USED

I have used the below components to build the weather station

Sl No	Image	Part	Purpose	Qty	Cost
1		Buy Raspberry Pi Zero 2 W Online at Robu.in	Receives data wirelessly and runs the software	1	₹ 1,649
2		Raspberry Pi Pico W (robu.in)	Connect the sensors and send data. Non-Wi-Fi variant of Pico will also work as we don't use Wi-Fi	1	₹ 539
3		Buy 2.54MM pitch 40 Pin Male Double Row (2x20) Pin Header Strip Breakable-10pcs (robu.in)	For the Raspberry Pi GPIO pins	1	₹ 45
4		SX1278 LoRa Module Ra- 02 433MHZ Wireless Spread Spectrum Transmission - Robocraze	To send and receive data	2	₹ 434
6		5V 3A ERD Power Adapter with Micro USB cable × 1	Power suppy for the Raspberry Pi	1	₹ 299
8		BME280 Temperature Sensor Module × 1	Measures temperature, humidity and atmospheric pressure	1	₹ 409
9		Weather Meter Kit SparkFun	To measure wind speed, wind direct and rainfall	1	₹ 7,841
10		HASTHIP® Wire Crimping Tool Wire Cutter Ratchet Wire Crimper Set with 1550PCS Dupont Connectors Male/Female Pin 0.1-1.0mm² for 2.54/3.96mm KF2510 Connector 28-18AWG	To connect wires to dupont conenctors	1	₹ 1,899

11		SanDisk Ultra 64GB microSDXC UHS-I, 140MB/s R, Memory Card, 10 Y Warranty, for Smartphones	Install Raspberry Pi OS	1	₹ 538
12		Buy 24 AWG Jumper Cable 150mm Red at the Best Price Online in India (robu.in)	Prefer various colours to make connections to the breadboard	1	₹ 68
13		Buy GL-12 840 Points Solderless Breadboard online at the best price in India | Robu.in	To connect the Pico and sensors	1	₹ 49
14		Buy 50 CM Micro USB Cable Online at Robu.in	Power up the Pico and transfer files	1	₹ 24
15		4.7k Ohm 0.5W Metal Film Resistor (Pack of 50)	For the circuit. We will only need 1	1	₹ 35
16		Plusivo Soldering Kit With Diagonal Wire Cutter × 1	To solder the sensors and parts to the board	1	₹ 1,366

The total cost of the components excluding the Dupont and soldering kit is ~ ₹12,000.

The cost without the Sparkfun Wind/Rain which is the most expensive component is ~ ₹4,000.

One of the things to do will be to see how the cost of Sparkfun kit can be brought down.

■ SOFTWARES

Software	Version	Used for
Raspberry Pi OS	Raspberry Pi OS Lite Release date: March 15th 2024 System: 32-bit Kernel version: 6.6 Debian version: 12 (bookworm)	I'm picking a non-desktop variant as I only need this to run the weather station and nothing else and the Zero 2 W hardware isn't very powerful
WeeWX	5	Storing data and frontend data display
Apache	2.4	Web server to display the reports generated by WeeWX in a web browser

🔗 REFERENCES AND CREDITS

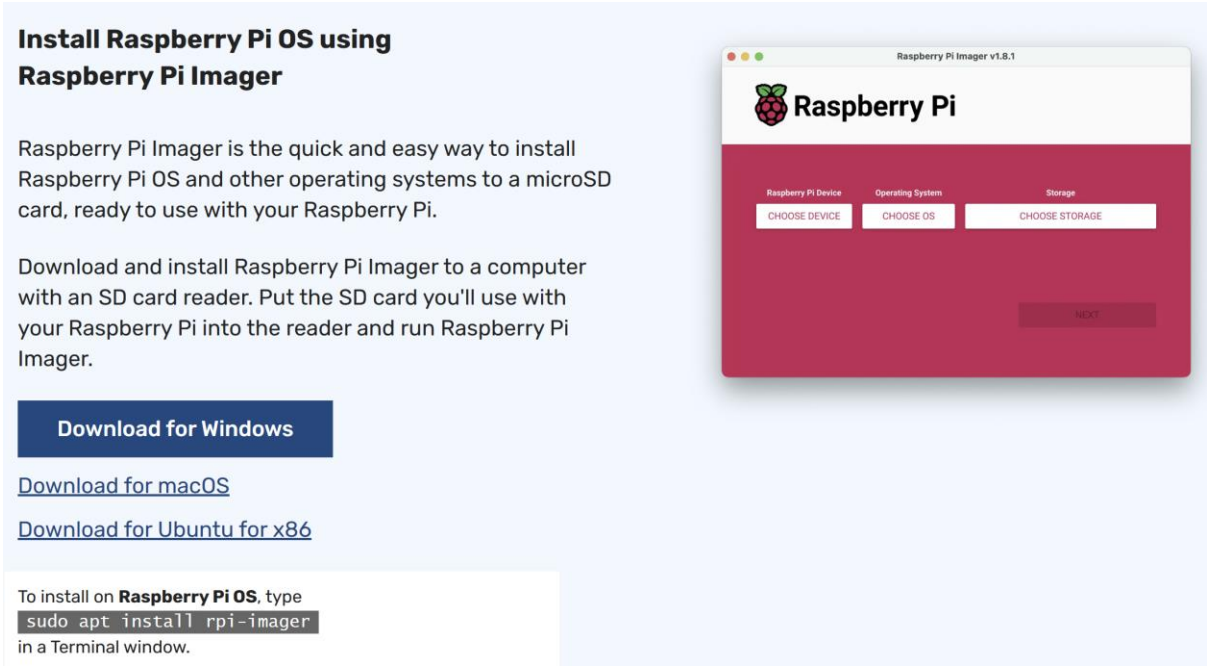
Source	Used For
Raspberry Pi Foundation - Build your own weather station	Tutorial to build the weather station hardware and base software
Raspberry Pi Oracle Weather Station Python Code	Starting point to write the code already written by Raspberry Pi Foundation
WeeWX	Storing data and frontend data display
WeeWX Wiki	Good information about WeeWX - between their base doc and this all can be found
Install Apache	Web server to display the reports generated by WeeWX in a web browser
WeeWX driver implementation of the Build Your Own Weather Station	Installation of the driver
jardiamj/BYOWS_RPi: weeWX Driver for Build Your Own Weather Station for Raspberry Pi (github.com)	Our Weewx driver will be a modification of this
chandrawi/LoRaRF-Python: Python library for basic transmitting and receiving data using LoRa and FSK modem (github.com)	LoRa receiver code that runs on Raspberry Pi
martynwheeler/u-lora: raspi-lora for micropython (github.com)	LoRa sender code that runs on Pico
_	
Other's blogs on how to get WeeWX to work	
_	
MATTHEW PIERCEY - MAKING A CUSTOM OFFLINE WEATHER STATION WITH WEEWX	Excellent resource to give information about other resources
Nev and Gays Home Weather	Another good resource for information about WeeWX
Setting up MQTT Broker	
_	
Other's Pi stations	
_	
BC Robotics Raspberry Pi Weather Station	Code
Raspberry Pi BME280 Weather Station Using Python and Flask	Very well documented by this guy and good instructions
Complete DIY Raspberry Pi Weather Station With Software	
Solar Powered WiFi Weather Station V2.0	
Open Weather Station	Done on an Aurdino
Uploading weather data to Weather Underground	Upload the data to Weather Underground
martynwheeler/u-lora: raspi-lora for micropython (github.com)	LoRa code for Pico

chandrawi/LoRaRF-Python: Python library for basic transmitting and receiving data using LoRa and FSK modem (github.com)	LoRa for Raspberry Pi

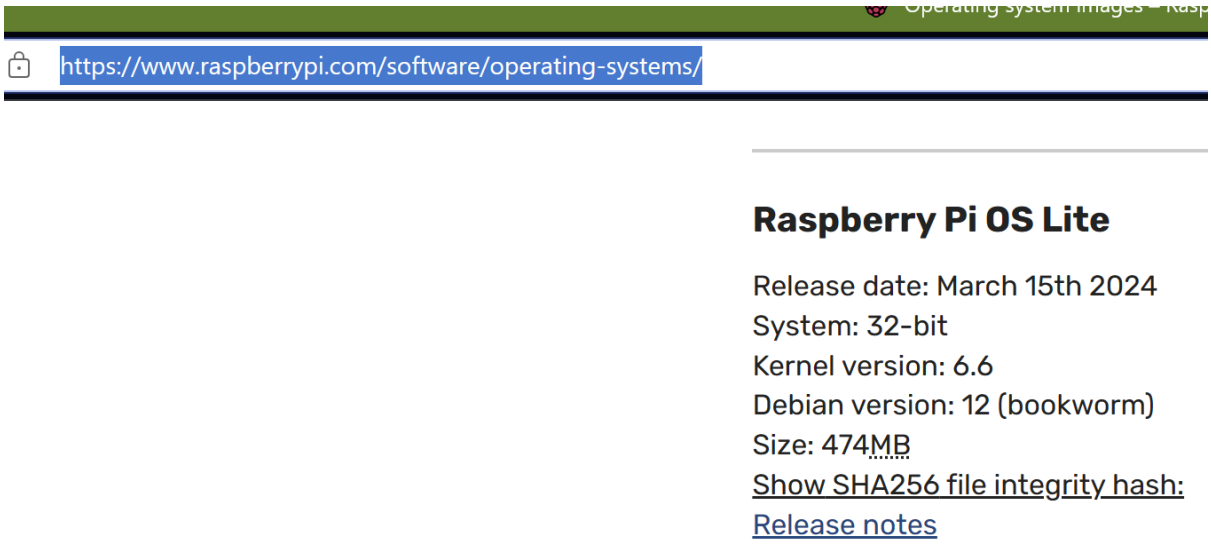
SETUP THE RASPBERRY PI

FLASHING THE IMAGE

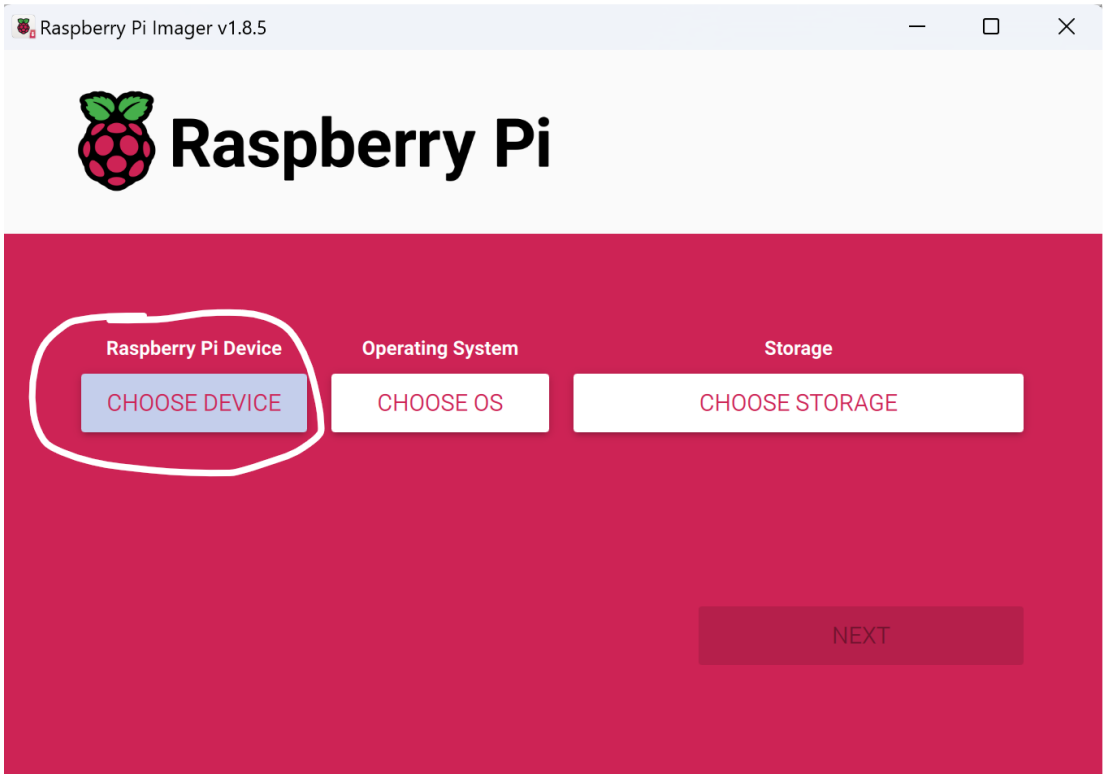
1. Download and install the Raspberry Pi Imager from [Raspberry Pi OS – Raspberry Pi] for Windows

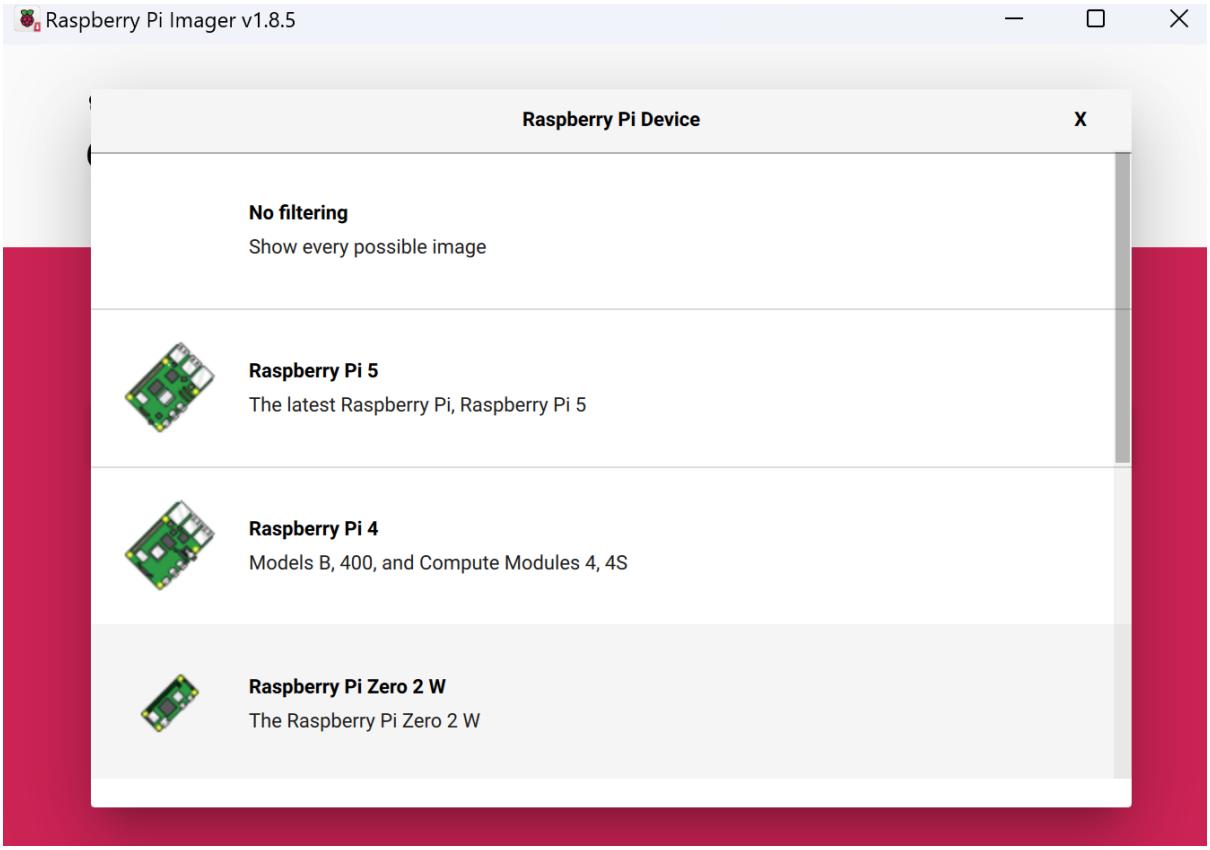


2. Insert the microSD card into the PC and launch the imager. The imager can download the required software and do the work, but in my case, I've downloaded the software ahead of time as I have internet restrictions at times.
Download the 32 bit Lite version software from [Operating system images – Raspberry Pi]

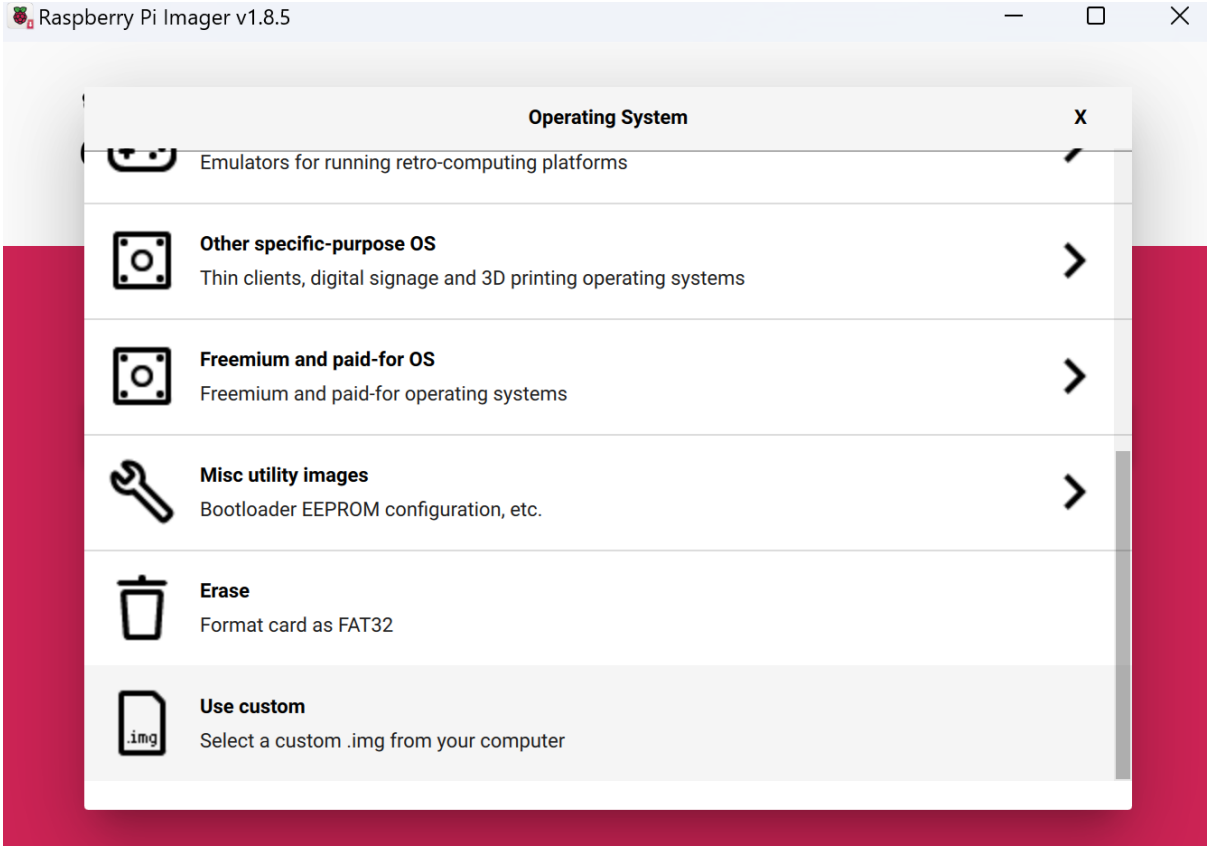


32-bit and lite version should do as I don't need a desktop and I'm using Raspberry Pi Zero 2 W which only has 512 MB of memory. So 64 bit isn't required and I don't want to overhead of running GUI. I'm only going to run the weather station software on this hardware.
3. Click on choose device and select Raspberry Pi Zero 2 W

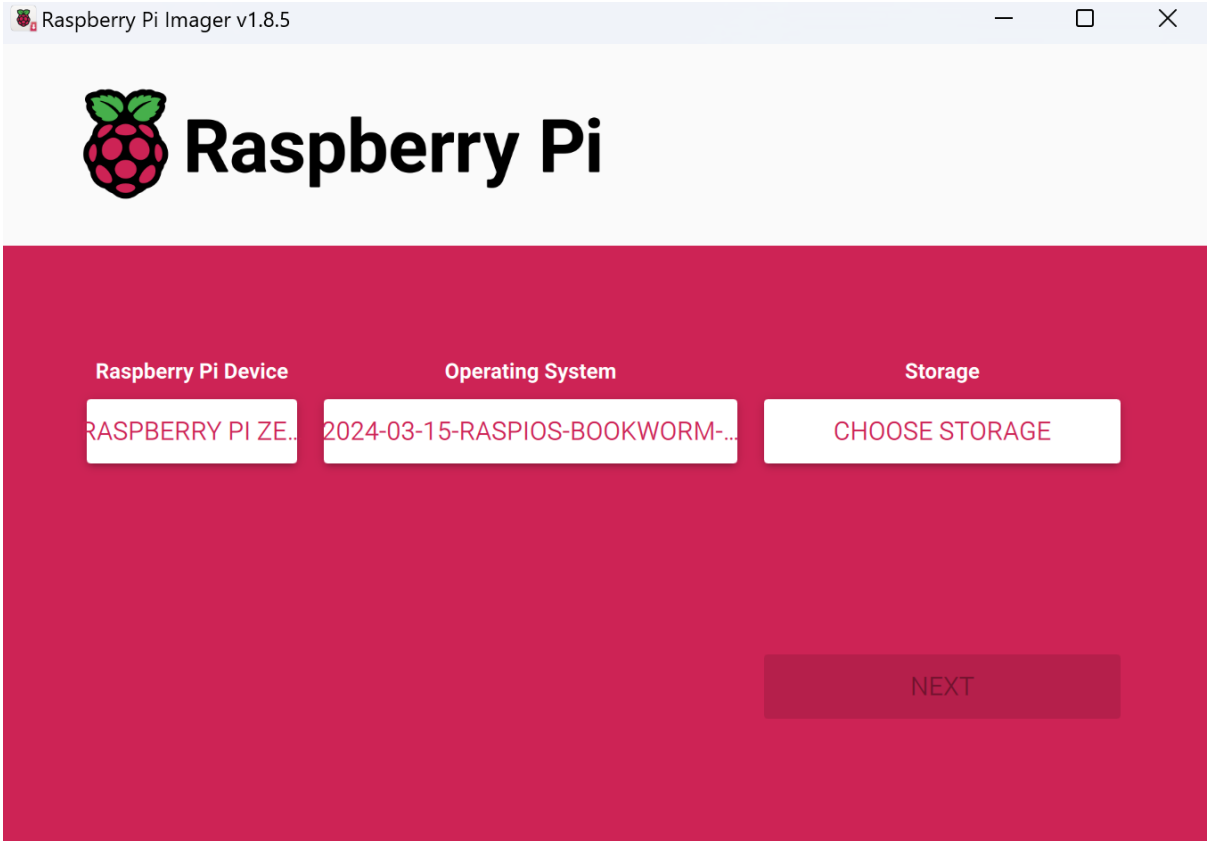




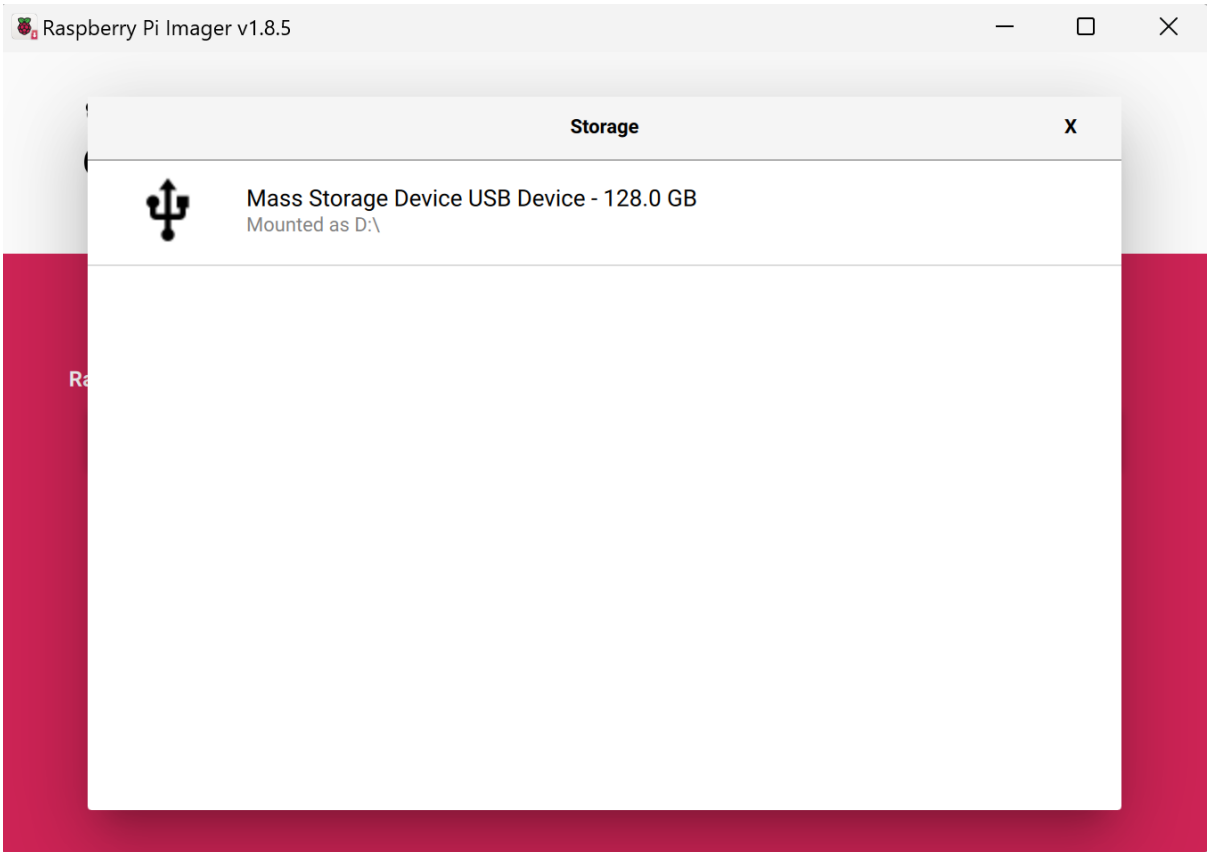
4. Next click on Choose OS -> Use custom (Select a custom .img from your computer



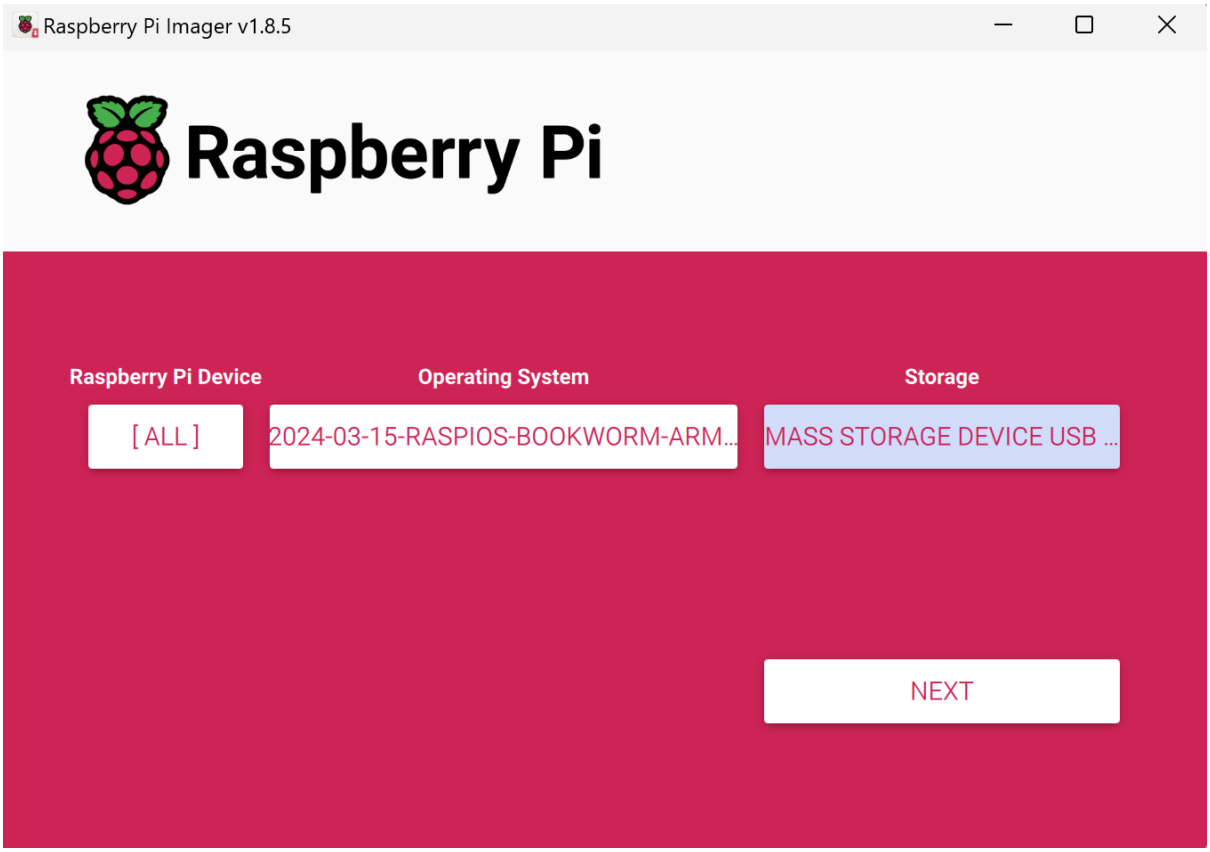
Select the 2024-03-15-raspios-bookworm-armhf-lite.img.xz file that was previously downloaded.

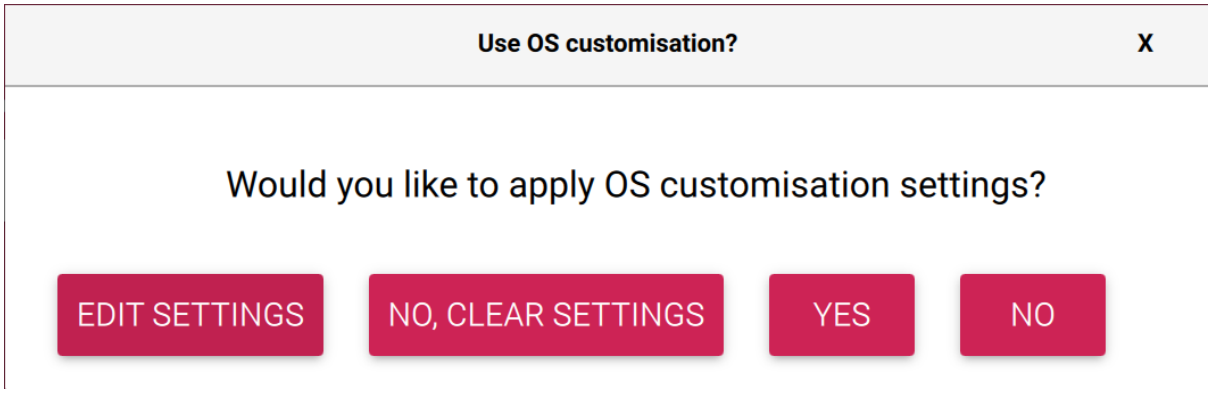


Select the storage

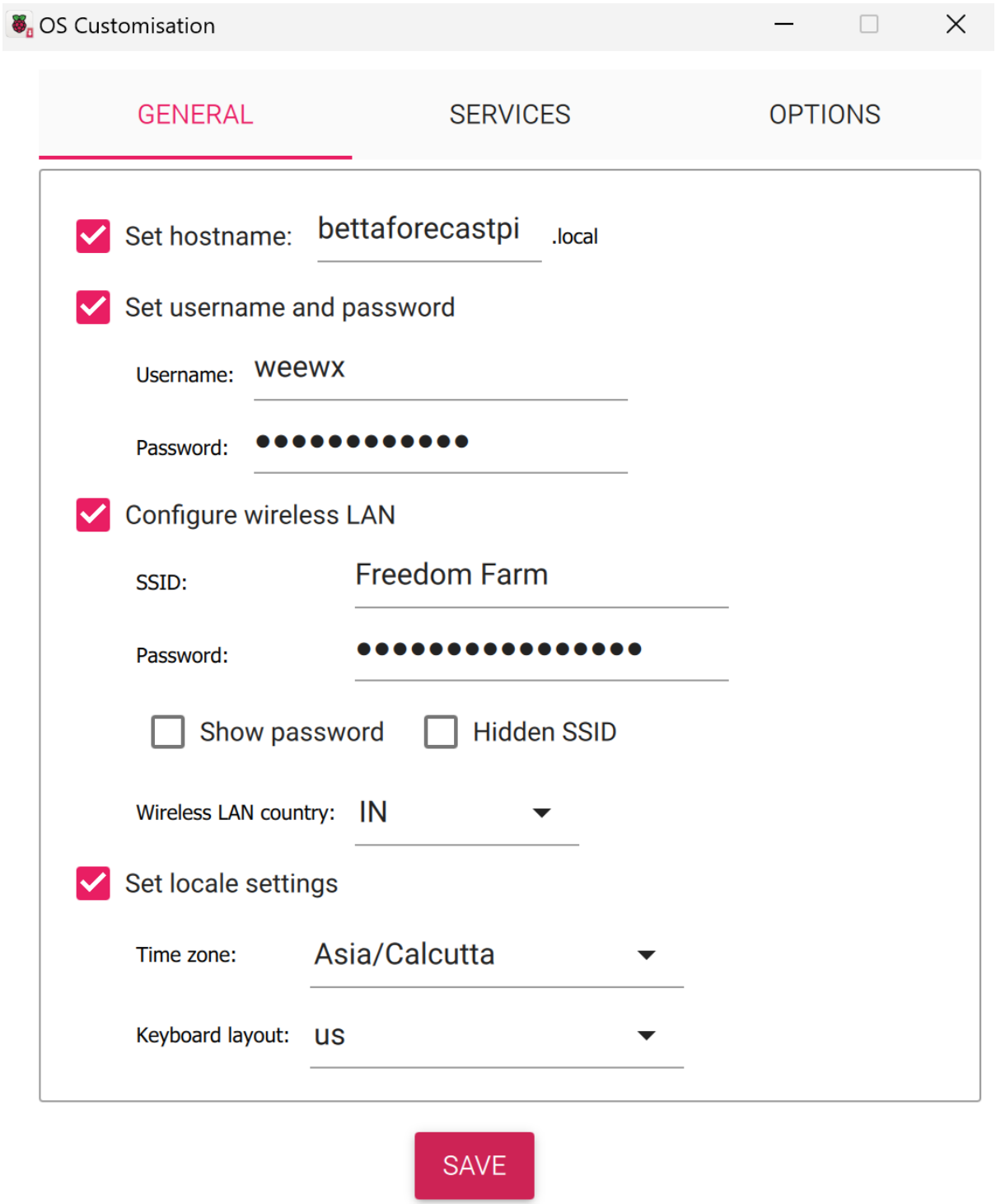

Raspberry Pi Imager v1.8.5
Storage
X
Mass Storage Device USB Device - 128.0 GB
Mounted as D:\

Click Next

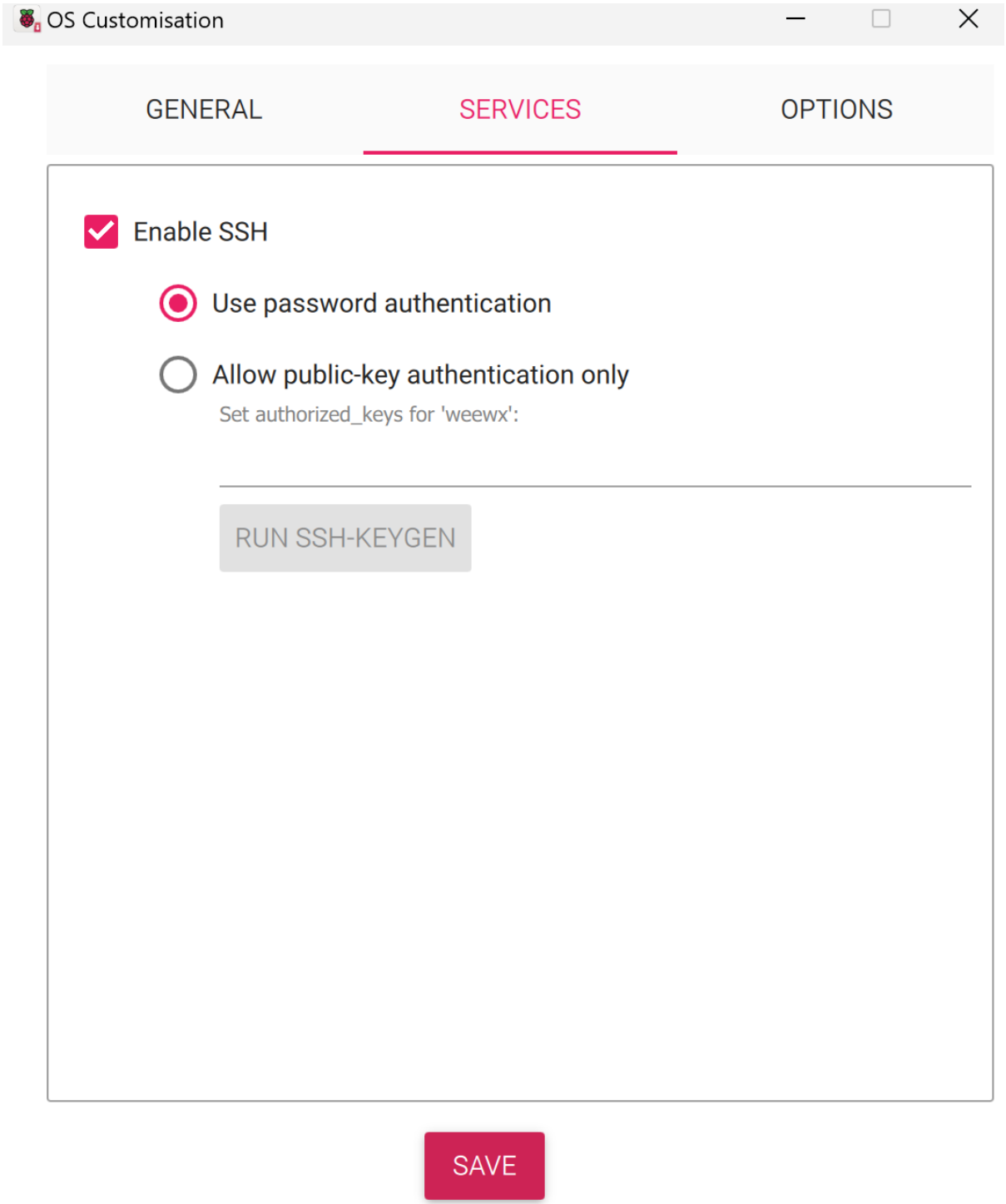

Raspberry Pi Imager v1.8.5
Raspberry Pi
Raspberry Pi Device
Operating System
Storage
[ALL]
2024-03-15-RASPIOS-BOOKWORM-ARM...
MASS STORAGE DEVICE USB ...
NEXT



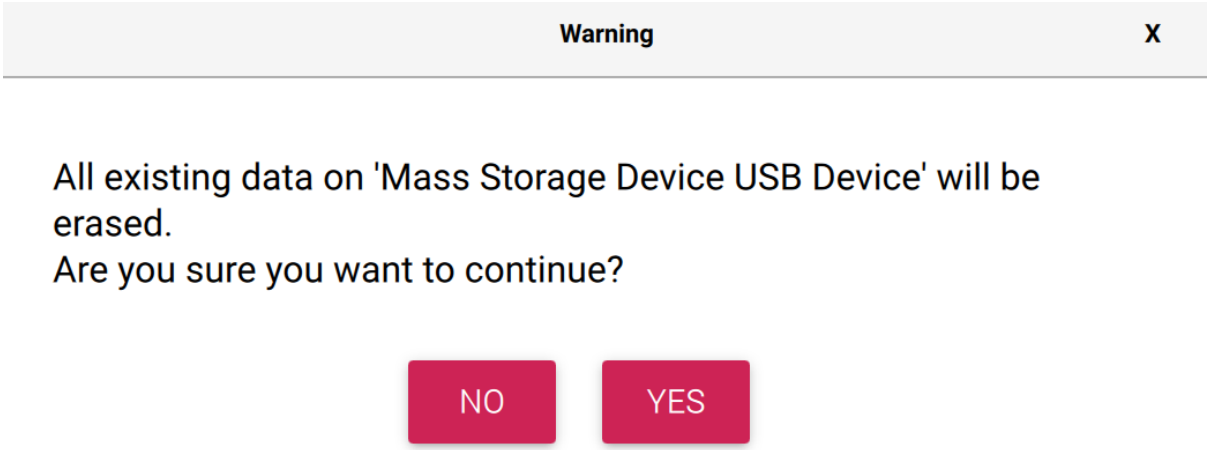
Edit Settings


OS Customisation
GENERAL
SERVICES
OPTIONS
Set hostname:
bettaforecastpi
.local
Set username and password
Username:
weewx
Password:
Configure wireless LAN
SSID:
Freedom Farm
Password:
Show password
Hidden SSID
Wireless LAN country:
IN
Set locale settings
Time zone:
Asia/Calcutta
Keyboard layout:
us
SAVE

Enable SSH



Click Save. Say Yes to apply customization and you will see the below screen. Say Yes



Once this is complete, remove the microSD card and insert it into the Pi.

🖥️ CONFIGURE THE OS

Now the Raspberry Pi is ready to be booted up. Plug it into the power source.

Using putty or any other terminal application, login. In my case the hostname is bettaforecastpi

■ CHECK FOR UPDATES

Update process hangs during a fresh installation of Raspberry Pi OS - Raspberry Pi Forums

There's an issue where the processes can hang and run out of memory as the RAM on the pi zero is just 512M and swap by default is 100M. Increase the swap to 1024M by editing the below file

```
weewx@bettaforecastpi:~ $ sudo vi /etc/dphys-swapfile
```

change CONF_SWAPSIZE=100 to 1024

Reboot for the changes to take effect.

```
weewx@bettaforecastpi:~ $ sudo reboot
```

Check for any updates

```
weewx@bettaforecastpi:~ $ sudo apt update
weewx@bettaforecastpi:~ $ sudo apt upgrade
```

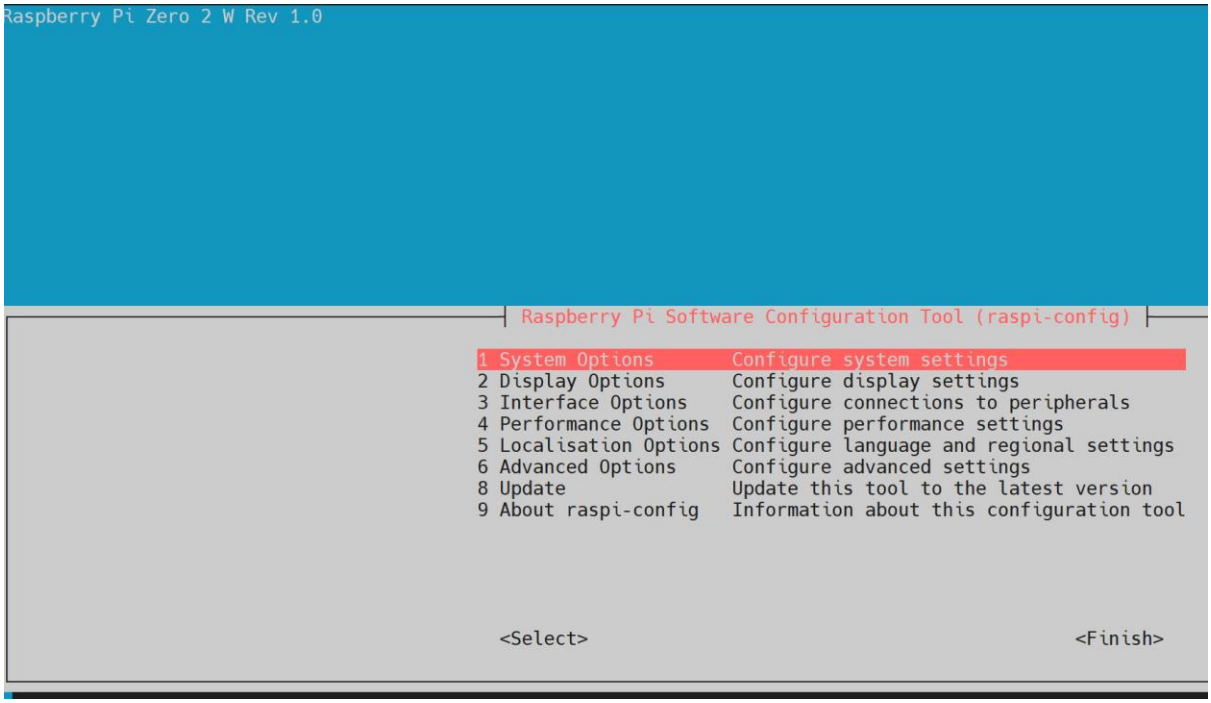
SETUP PRIVATE/PUBLIC KEY FOR PASSWORDLESS LOGIN (OPTIONAL)

See the section "SETUP KEYPAIR FOR WEEWX TO LOGIN WITHOUT A PASSWORD" for details on how to generate the keypair. The same steps apply here.
Once you have completed the setup, you should be able to login as weewx without any password.

CONFIGURE THE PI TO ENABLE CERTAIN OPTIONS

Run the command

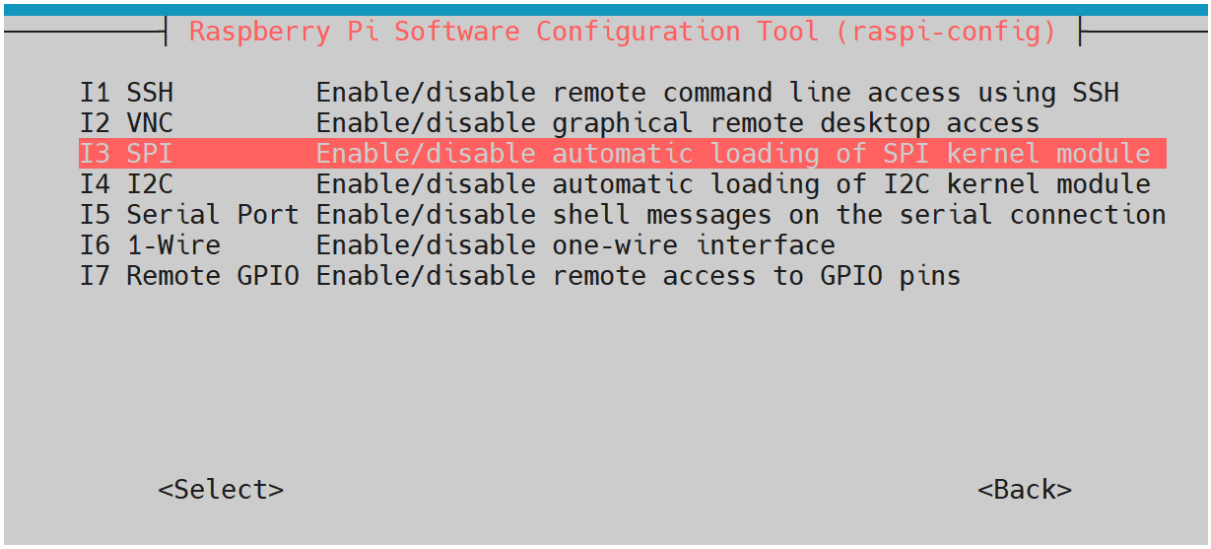
```
weewx@bettaforecastpi:~ $ sudo raspi-config
```



Select "8 Update"

Then run the below option to enable interfaces

3 Interface Options



Enable SPI, I2C, Serial Port, 1-Wire and Remote GPIO. Click Finish once done.

🛠 INSTALL PIP

```
weewx@bettaforecastpi:~ $ mkdir weather-station/
weewx@bettaforecastpi:~ $ cd weather-station/
weewx@bettaforecastpi:~/weather-station $ sudo apt install python3-pip
weewx@bettaforecastpi:~/weather-station $ pip --version
```

```
pip 23.0.1 from /usr/lib/python3/dist-packages/pip (python 3.11)
```

We get the below error when we try to install anything with pip.

```
error: externally-managed-environment

× This environment is externally managed
╰─> To install Python packages system-wide, try apt install
    python3-xyz, where xyz is the package you are trying to
    install.

    If you wish to install a non-Debian-packaged Python package,
    create a virtual environment using python3 -m venv path/to/venv.
    Then use path/to/venv/bin/python and path/to/venv/bin/pip. Make
    sure you have python3-full installed.

    For more information visit http://rptl.io/venv

note: If you believe this is a mistake, please contact your Python
installation or OS distribution provider. You can override this, at the
risk of breaking your Python installation or OS, by passing --break-system-
packages.
hint: See PEP 668 for the detailed specification.
```

Solution: https://www.makeuseof.com/fix-pip-error-externally-managed-environment-linux/

Remove the EXTERNALLY-MANAGED EXTERNALLY-MANAGED file

```
weewx@bettaforecastpi:/usr/lib/python3.11 $ cd /usr/lib/python3.11
weewx@bettaforecastpi:/usr/lib/python3.11 $ sudo mv EXTERNALLY-MANAGED EXTERNALLY-MANAGED.orig
weewx@bettaforecastpi:/usr/lib/python3.11 $ cd ~/weather-station/
```

SETUP THE RASPBERRY PI PICO

FLASHING THE IMAGE

Source: MicroPython - Raspberry Pi Documentation

I will be using Micropython to write the code.

Download the correct MicroPython UF2 file for your board:

- Raspberry Pi Pico
- Raspberry Pi Pico W with Wi-Fi and Bluetooth LE support

Documentation introducing working with Wi-Fi and Bluetooth on Raspberry Pi Pico W with C/C++ or MicroPython is presented in the Connecting to the Internet with Raspberry Pi Pico W book. Full details of supported Bluetooth protocols and profiles are Blue Kitchen BTStack Github repository.

Note: MicroPython distributions for other RP2040-based boards are available on the MicroPython download page.

Then go ahead and:

1. Push and hold the BOOTSEL button and plug your Pico into the USB port of your Raspberry Pi or other computer. Release the BOOTSEL button after your Pico is connected.
2. It will mount as a Mass Storage Device called RPI-RP2.
3. Drag and drop the MicroPython UF2 file onto the RPI-RP2 volume. Your Pico will reboot. You are now running MicroPython.
4. You can access the REPL via USB Serial.

The Raspberry Pi Pico Python SDK book contains step-by-step instructions for connecting to your Pico and programming it in MicroPython using both the command line and the Thonny IDE.

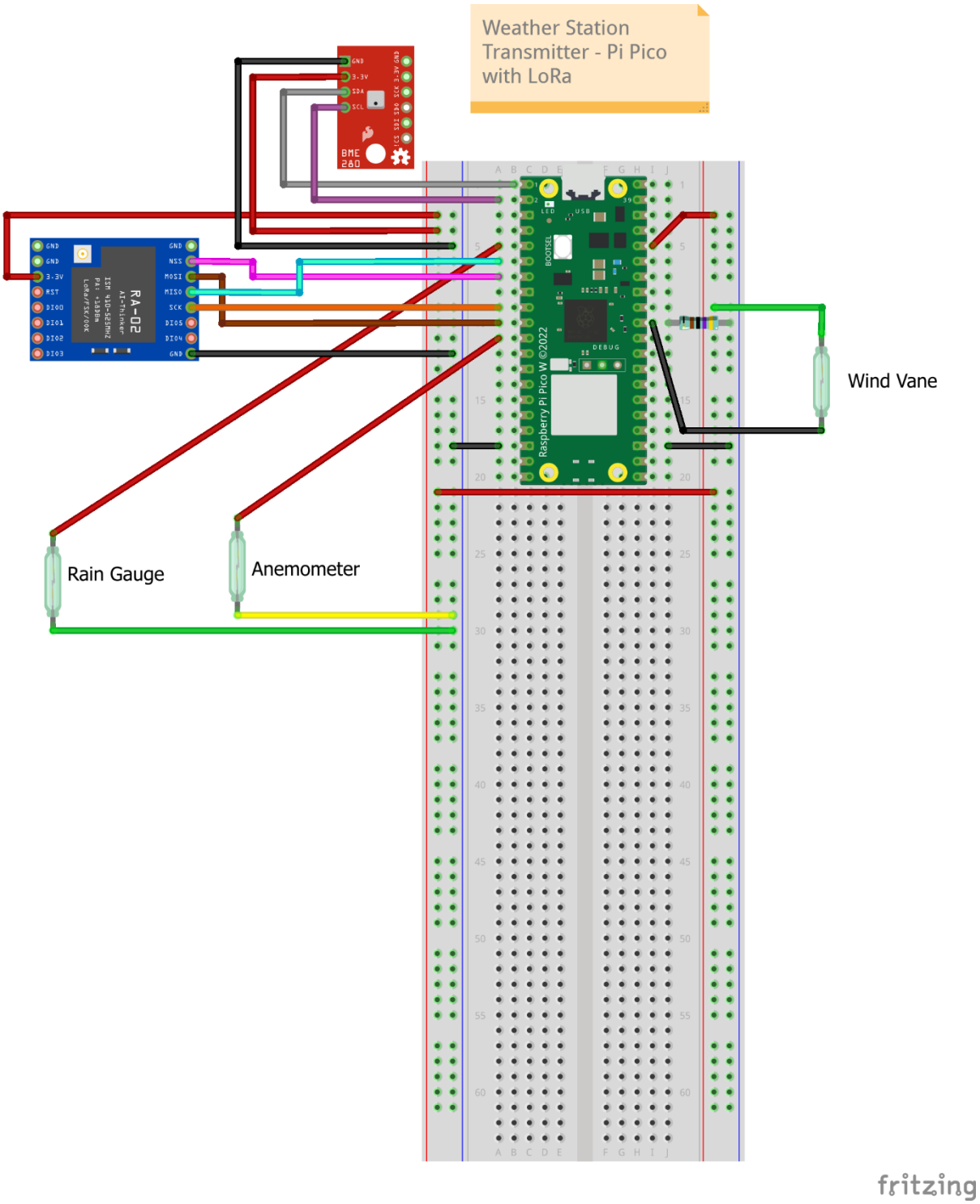
SETUP THE WEATHER STATION

SETUP THE WEATHER METER

Follow the instructions at Weather Meter Hookup Guide - SparkFun Learn to set up the wind vane, anemometer and rain gauge.

CONNECT THE SENSORS AND LORA TO PICO - SENDER

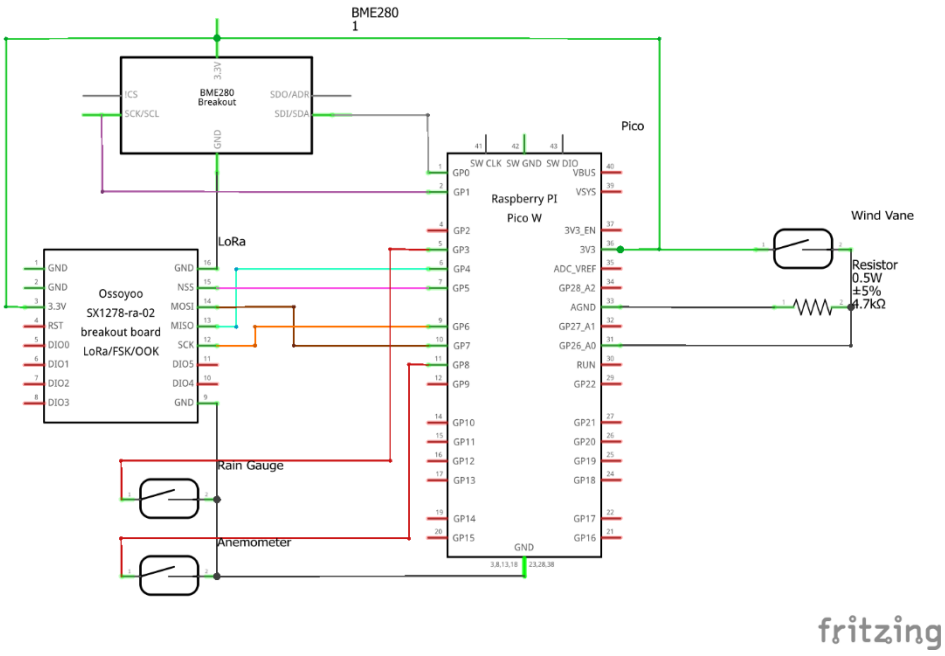
Follow the wiring diagram and connect the components – BME280, LoRa, Wind Vane, Anemometer (this doesn't connect directly but connects to the wind vane), and Rain Gauge. The Pico will act as the sender that will transmit the weather data to the Pi zero.



In my case, I have stripped the RJ 11 jacks from the rain gauge and Wind Vane as it was hard for me to procure RJ 11 female jacks. So I connect the wires directly to the board using Dupont connectors. 4

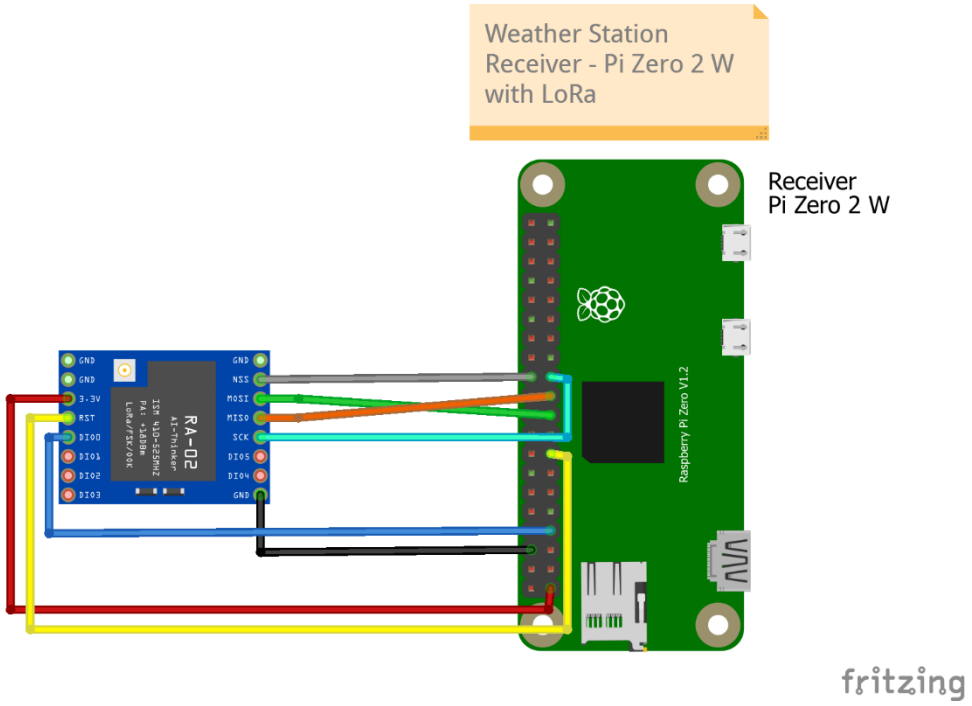
wires come from the wind vane (2 for the wind vane and 2 for the anemometer) and 2 from the rain gauge. They are color-coded as shown in the diagram. The polarity doesn't matter.

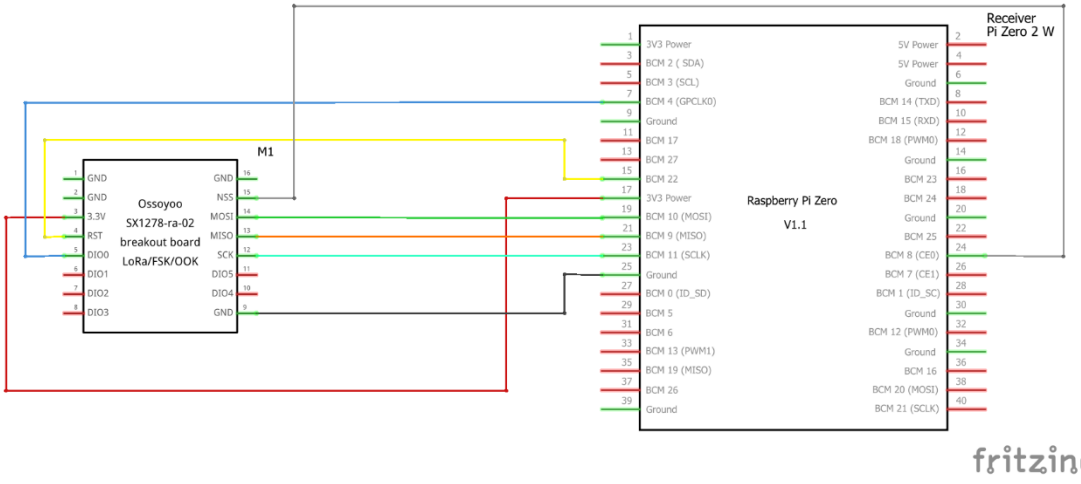
Below is the schematic representation of the connections.



CONNECT LORA TO PI - RECEIVER

Connect the LoRa receiver as per the below diagram to the Raspberry Pi.




Receiver
Pi Zero 2 W
M1
Ossoyoo
SX1278-ra-02
breakout board
LoRa/FSK/OOK
GND
GND
3.3V
RST
DIO0
DIO1
DIO2
DIO3
GND
NSS
MOSI
MISO
SCK
DIO5
DIO4
GND
Raspberry Pi Zero
V1.1
3V3 Power
BCM 2 (SDA)
BCM 3 (SCL)
BCM 4 (GPCLK0)
Ground
BCM 17
BCM 27
BCM 22
3V3 Power
BCM 10 (MOSI)
BCM 9 (MISO)
BCM 11 (SCLK)
Ground
BCM 0 (ID_SD)
BCM 5
BCM 6
BCM 13 (PWM1)
BCM 19 (MISO)
BCM 26
Ground
5V Power
5V Power
Ground
BCM 14 (TXD)
BCM 15 (RXD)
BCM 18 (PWM0)
Ground
BCM 23
BCM 24
Ground
BCM 25
BCM 8 (CE0)
BCM 7 (CE1)
BCM 1 (ID_SC)
Ground
BCM 12 (PWM0)
Ground
BCM 16
BCM 20 (MOSI)
BCM 21 (SCLK)
fritzing

■ SETUP THE SOFTWARE CODE (PROGRAM)

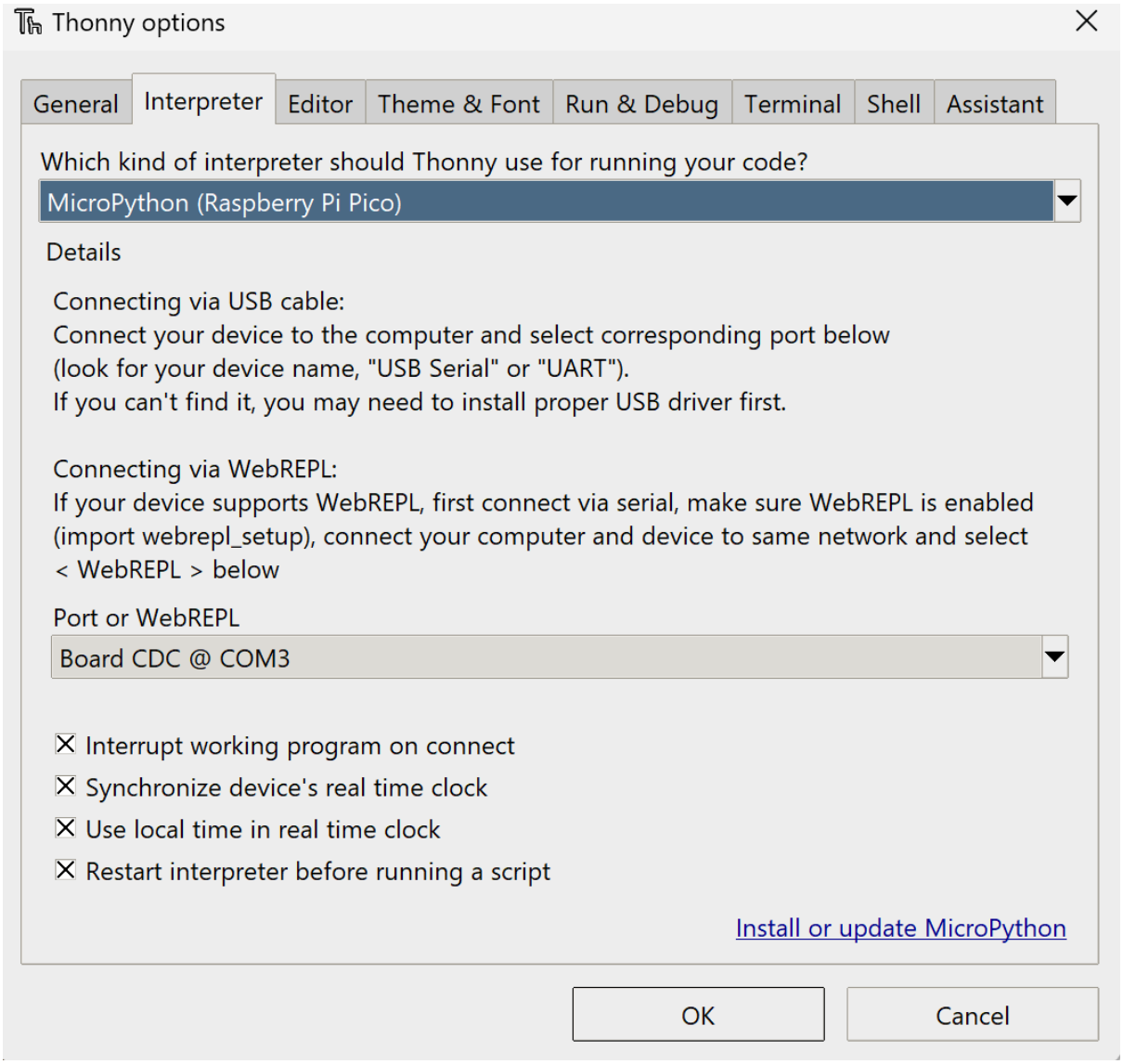
Reference: What you will need | Build your own weather station | Python | Coding projects for kids and teens (raspberrypi.org)

PICO

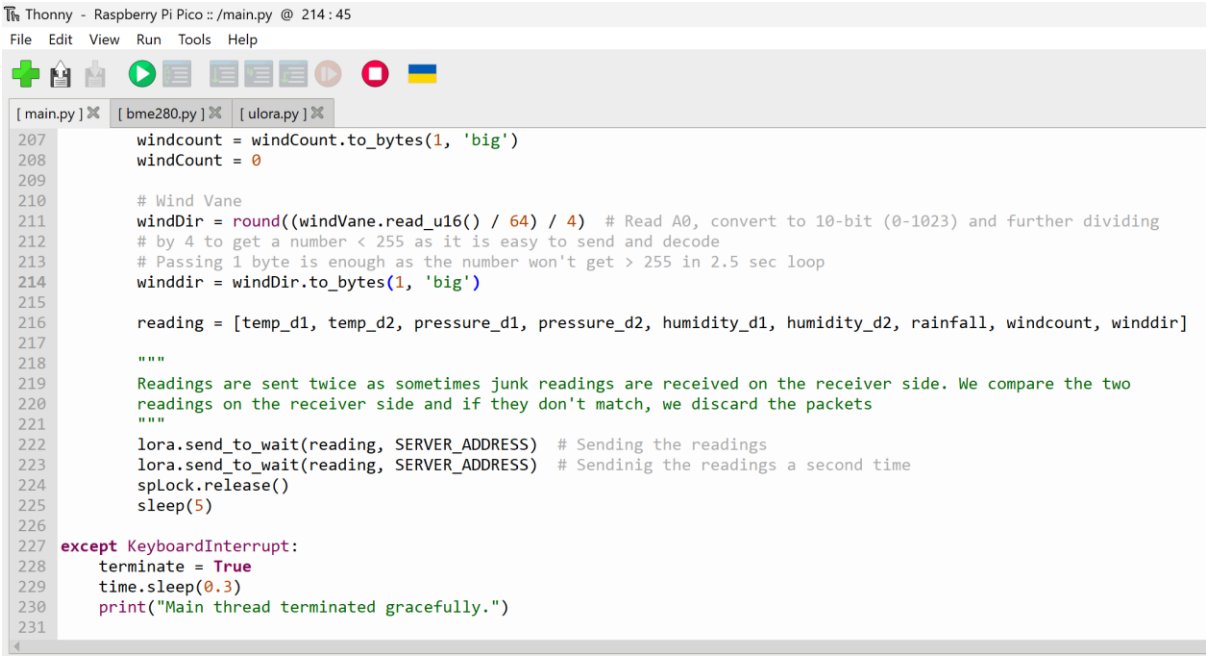
Download the code from GitHub Pico Code from GitHub

Install Thonny, Python IDE for beginners if not already done so.

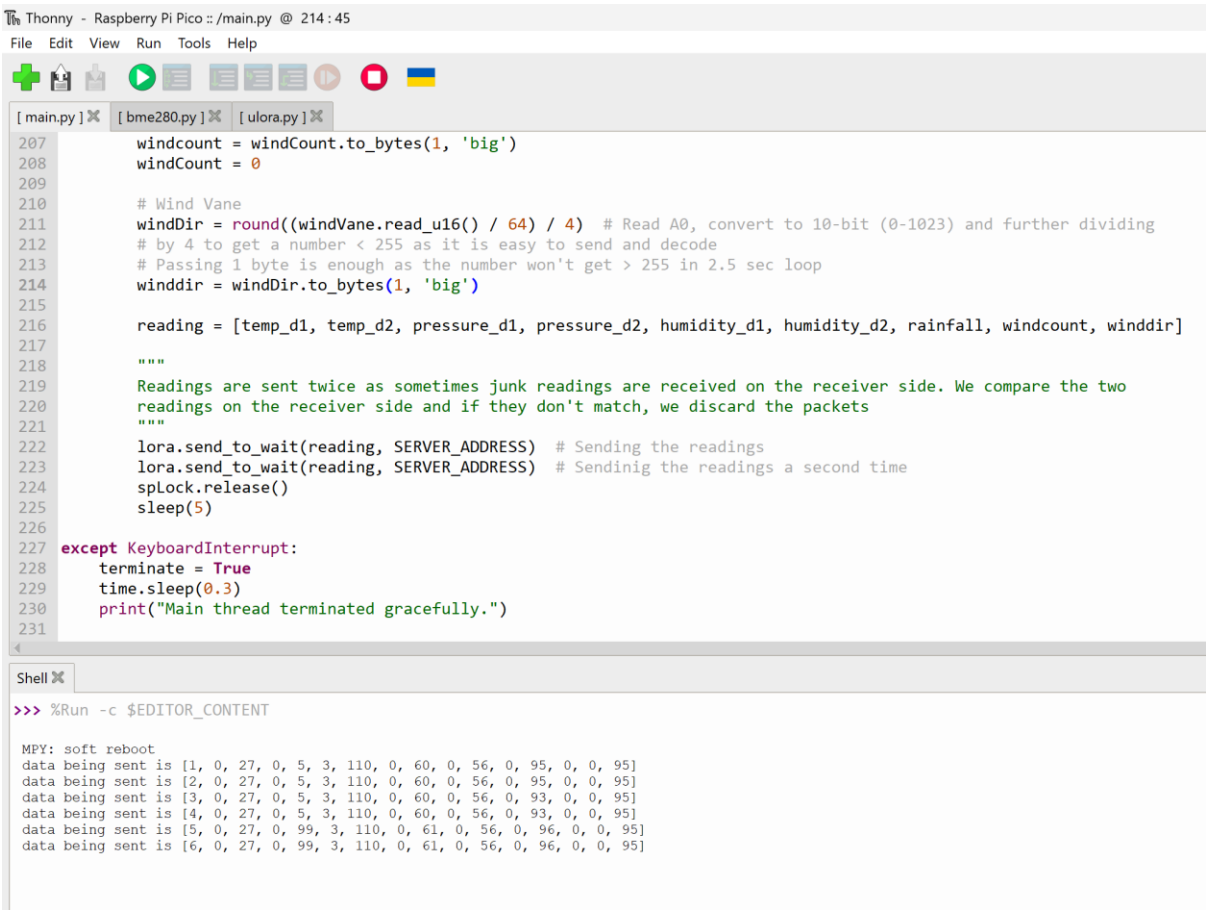
Once the Pico is connected to the PC, Thonny should be able to recognize it automatically. If it doesn't recognize the Pico, ensure the settings are correct.



Copy the files main.py, bme280.py and ulora.py using Thonny IDE to Pico. Pico will automatically run main.py every time it is powered up.



At this point hit run and you should see the packets being sent



We will install Weewx on the Pi and get the data directly into Weewx

INSTALL WEEWX

Source: Debian - WeeWX 5.0

Tell your system to trust weewx.com.

```
weewx@bettaforecastpi:~/weather-station $ sudo apt install -y wget gnupg
wget -qO - https://weewx.com/keys.html | \
    sudo gpg --dearmor --output /etc/apt/trusted.gpg.d/weewx.gpg
```

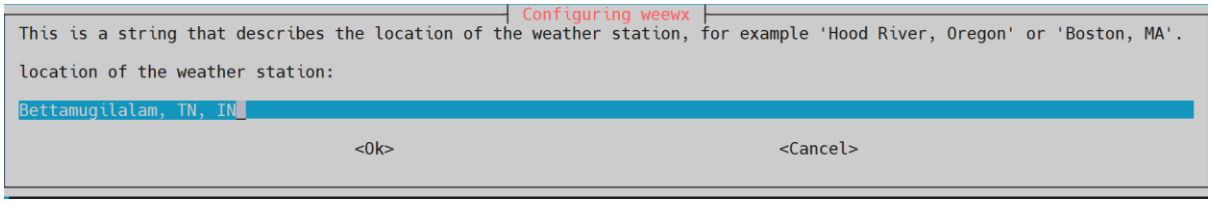
Tell **apt** where to find the WeeWX repository.

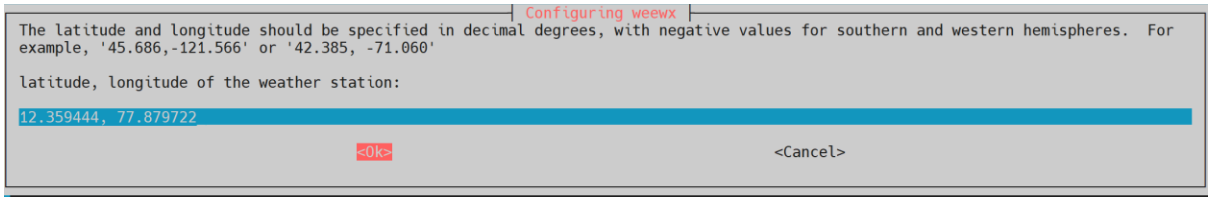
```
weewx@bettaforecastpi:~/weather-station $ echo "deb [arch=all] https://weewx.com/apt/python3
buster main" | \
    sudo tee /etc/apt/sources.list.d/weewx.list
```

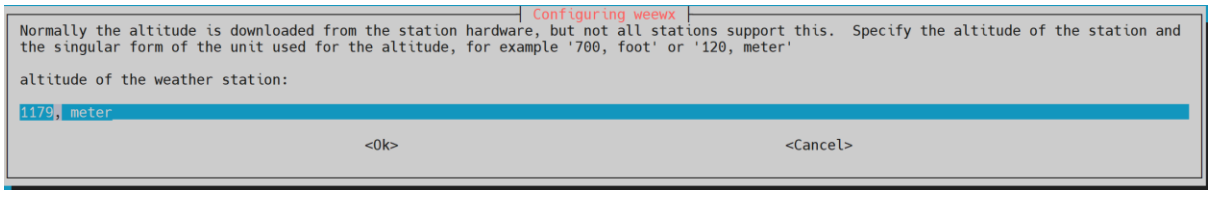
Install

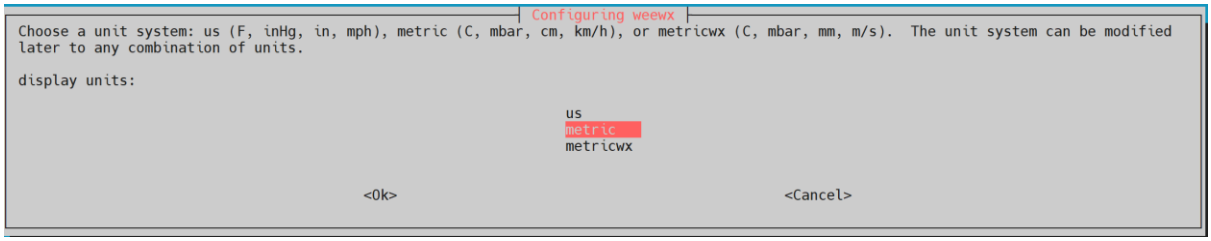
Use **apt** to install WeeWX. The installer will prompt for a location, latitude/longitude, altitude, station type, and parameters specific to your station hardware. When you are done, WeeWX will be running in the background.

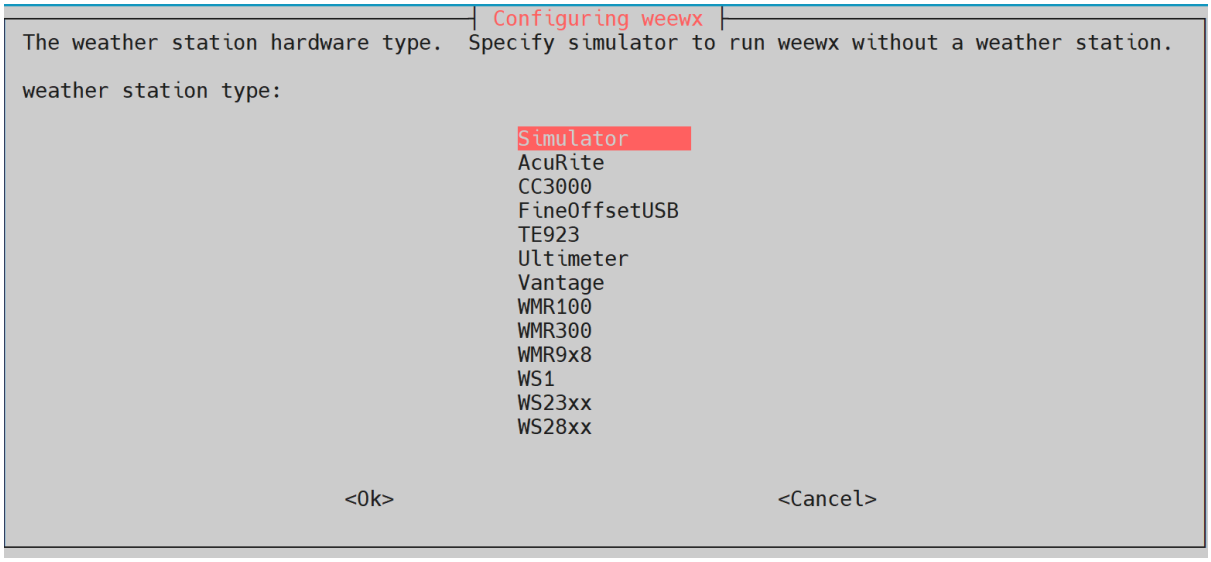
```
sudo apt update
sudo apt install weewx
```

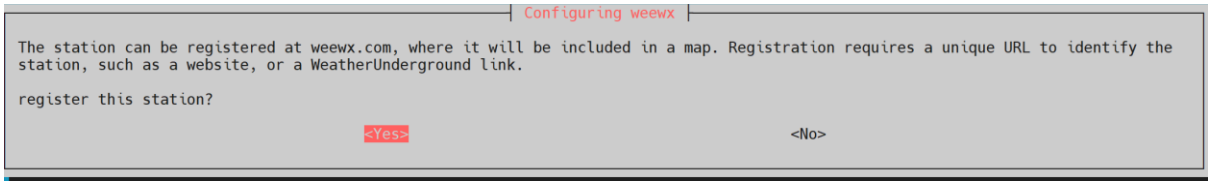


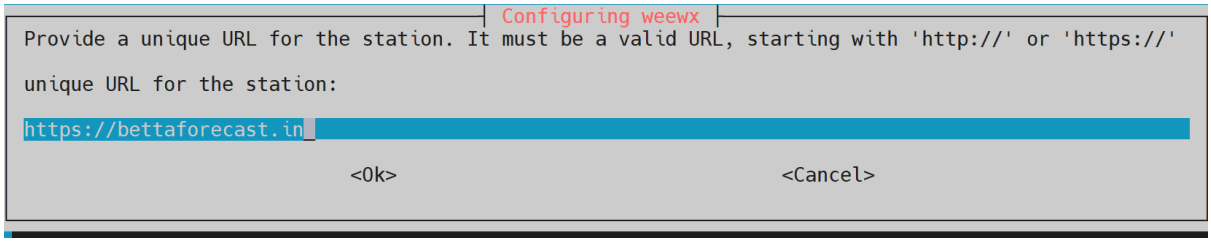












Install Apache.

After installing Apache, the default Weewx page is accessible from

http://[IP_OR_HOSTNAME_OF_PI]/weewx

RASPBERRY PI DRIVER FOR WEEWX

Source: BYOWS_RPi/bin/user/byows_rpi.py at master · jardiamj/BYOWS_RPi · GitHub

BYOWS_RPi/README.md at master · jardiamj/BYOWS_RPi (github.com)

I have modified the BYOWS_RPI driver to include LoRa communication.

INSTALLATION

download the latest release from GitHub into your WeeWx directory

Path:
https://github.com/vrishabkakade/wireless_weatherstation_v1/blob/0f4f853722ce6556a7ca550df5c1a6cfaac60785/Pi%20Zero%20code/BYOWS_RPi_LoRa-v1.zip

```
wget
https://github.com/vrishabkakade/wireless_weatherstation_v1/blob/0f4f853722ce6556a7ca550df5c1a6cfaac60785/Pi%20Zero%20code/BYOWS_RPi_LoRa-v1.zip
```

Once it is downloaded, run the WeeWX Extension installer. This will install the driver and add the default configuration items to your WeeWX.conf file

```
sudo weectl extension BYOWS_RPi_LoRa-v1.zip
```

CONFIGURATION

To enable the byows_rpi_lora driver modify the weewx.conf file and change the "station_type" variable to "BYOWS_LORA" in the "[Station]" section. Configure the driver by looking for the BYOWS stanza at the end of the file.

```
weewx@bettaforecastpi:~ $ cd /etc/weewx/
weewx@bettaforecastpi:/etc/weewx $ sudo vi weewx.conf
```

The driver automatically adds the below parameters.

The sender sends the data every 5 seconds to conserve power. This collection frequency can be altered on the Pico side by changing the sleep to the required time.

```
[BYOWS_LORA]
    # [REQUIRED]
    # The driver to use.
    driver = user.byows_rpi_lora
    loop_interval = 5
```

Install numpy as the signal strength calculation uses it.

```
sudo pip3 install numpy
```

👨‍🔧 CUSTOMIZATION

I couldn't get Weewx to run as a non-root user through the service. It works fine from the command line. To run it as root, comment out the user and group from the below file.

```
weewx@bettaforecastpi:/etc/weewx/bin/user $ sudo cp /lib/systemd/system/weewx.service
/lib/systemd/system/weewx.service.orig
weewx@bettaforecastpi:/etc/weewx/bin/user $ sudo vi /lib/systemd/system/weewx.service
```

```
Comment
#User=weewx
#Group=weewx
```

Reload the service and check the status.

```
weewx@bettaforecastpi:/etc/weewx/bin/user $ sudo systemctl daemon-reload
weewx@bettaforecastpi:/etc/weewx/bin/user $ sudo systemctl start weewx
weewx@bettaforecastpi:/etc/weewx/bin/user $ sudo systemctl status weewx
```

At this point, you will get a basic weather station dashboard working with Weewx

Not secure | sandboxpizero.local/weewx/index.html

Bettamugilalam, TN, India

17/06/24 14:45:00

Current Conditions

Outside Temperature	**26.9°C**
Heat Index	**27.8°C**
Wind Chill	**26.9°C**
Dew Point	**17.7°C**
Outside Humidity	**57%**
Barometer	**1005.0 mbar (-2.4)**
Wind	**0 km/h N/A (N/A)**
Rain Today	**0.31 cm**
Rain Rate	**0.00 cm/h**
UV Index	**N/A**
Radiation	**N/A**
Inside Temperature	**N/A**
Inside Humidity	**N/A**

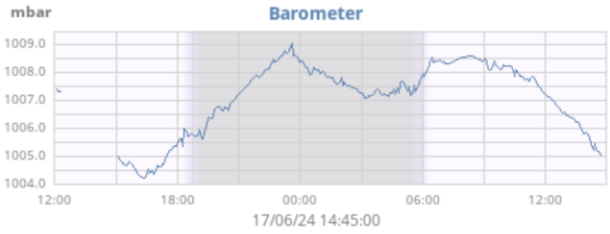
Celestial

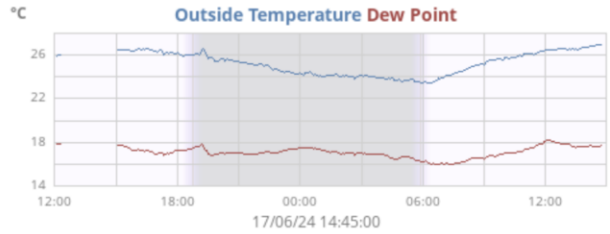
☀		☽	
Rise	**05:53:51**	Rise	**14:40:36**
Set	**18:45:08**	Set	**01:57:00**
Daylight	**12:51**		**Waxing gibbous 79%**

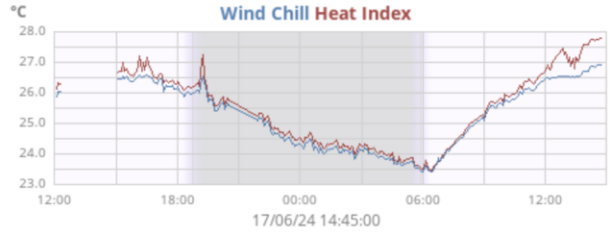
Statistics

	Today
Outside Temperature	**31.7** °C **16.0**
Heat Index	**36.7** °C

History: Day Week Month Year







SETUP THE VIRTUAL PRIVATE SERVER (VPS) (OPTIONAL)

You can do this step if you want to publish the data in real time to a dedicated server on the internet. You can see an example of this on my site Bettamugilalam, TN, India Weather Conditions (bettaforecast.in).

I do this as I'm unable to access my Pi directly from the internet due to complications with getting a public IP on a mobile network and I don't want to open up access directly to the Pi from the internet.

SETUP THE VPS SERVER TO ACT AS WEBSERVER

I have procured a VPS from Annai Tech. I will use this to act as the webserver to display the front end.

```
DISTRIB_ID: Ubuntu
DISTRIB_RELEASE: 22.04
```

CREATE USERNAME

Create a username called weewx that we will use to install the web server

Source: How to Create Users in Linux (useradd Command) | Linuxize

```
root@cloud009:~# useradd weewx
root@cloud009:~# id weewx
```

```
uid=1000(weewx) gid=1000(weewx) groups=1000(weewx)
```

Create user password

```
root@cloud009:~# passwd weewx
```

```
New password:
Retype new password:
passwd: password updated successfully
```

Since -m option wasn't passed when creating the user, run the below command to add home directory for the weewx user

```
root@cloud009:~# mkhomedir_helper weewx
```

CHANGE THE DEFAULT SHELL OF WEEX TO BASH

```
$ echo $SHELL
```

```
/bin/sh
```

```
$ cat /etc/shells
```

```
# /etc/shells: valid login shells
/bin/sh
/bin/bash
/usr/bin/bash
/bin/rbash
/usr/bin/rbash
/usr/bin/sh
/bin/dash
/usr/bin/dash
/usr/bin/tmux
/usr/bin/screen
```

```
$ chsh
```

```
Password:
Changing the login shell for weewx
Enter the new value, or press ENTER for the default
        Login Shell [/bin/sh]: /bin/bash
```

```
$ echo $SHELL
```

```
/bin/sh
```

CHANGE SHELL COLOR FOR WEEWX TO GREEN

This will help identify if I've logged in as root or weewx

```
weewx@cloud009:~$ cp .bashrc .bashrc.orig
weewx@cloud009:~$ vi .bashrc
```

Add the below

```
export PS1="\e[0;31m[\u@\h \w]\$ \e[m"
source ~/.bashrc
```

CHANGE SHELL COLOR FOR ROOT TO RED

```
root@cloud009:~# cp .bashrc .bashrc.orig
root@cloud009:~# vi .bashrc
```

Add the below

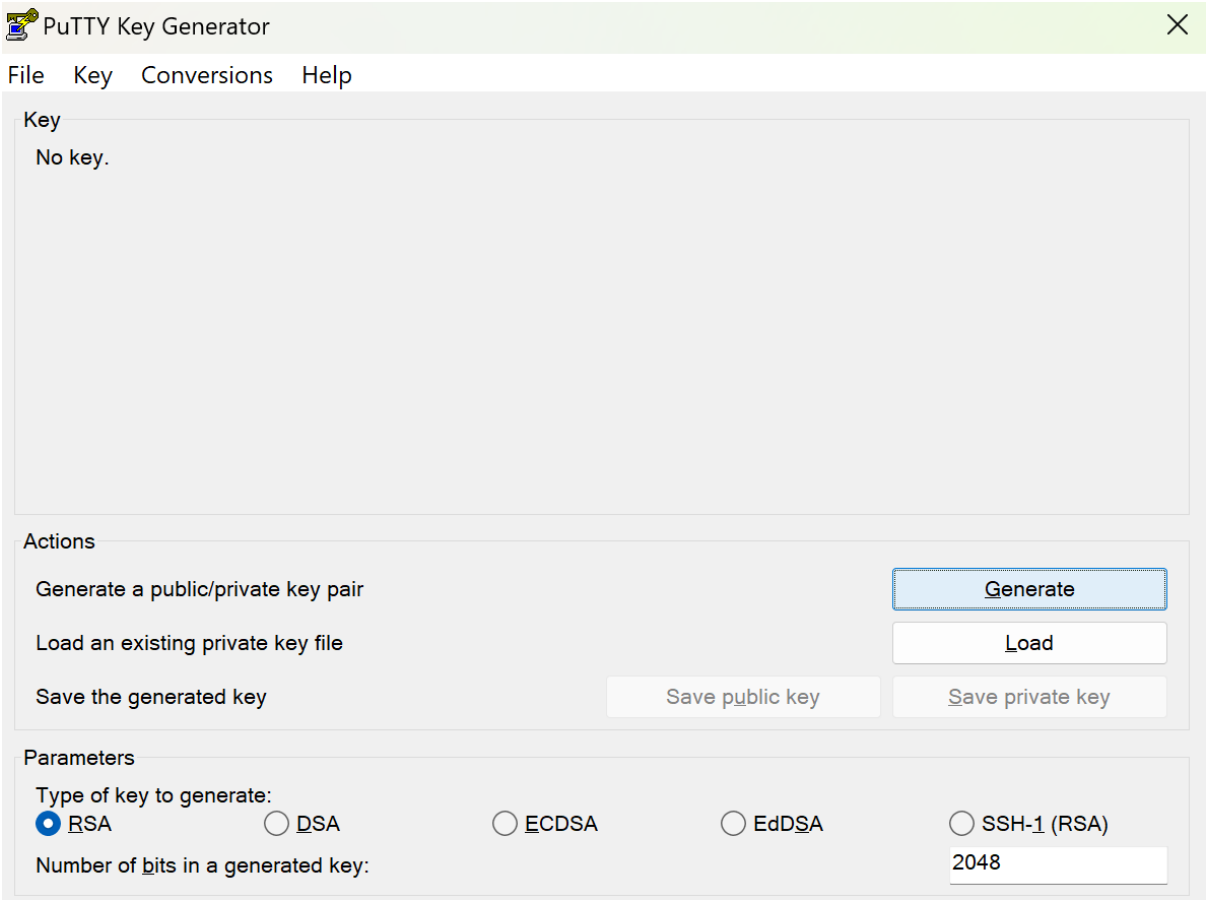
```
export PS1="\e[0;32m[\u@\h \w]\$ \e[m"
source ~/.bashrc
```

Here is a reference of all the colour codes that can be used.

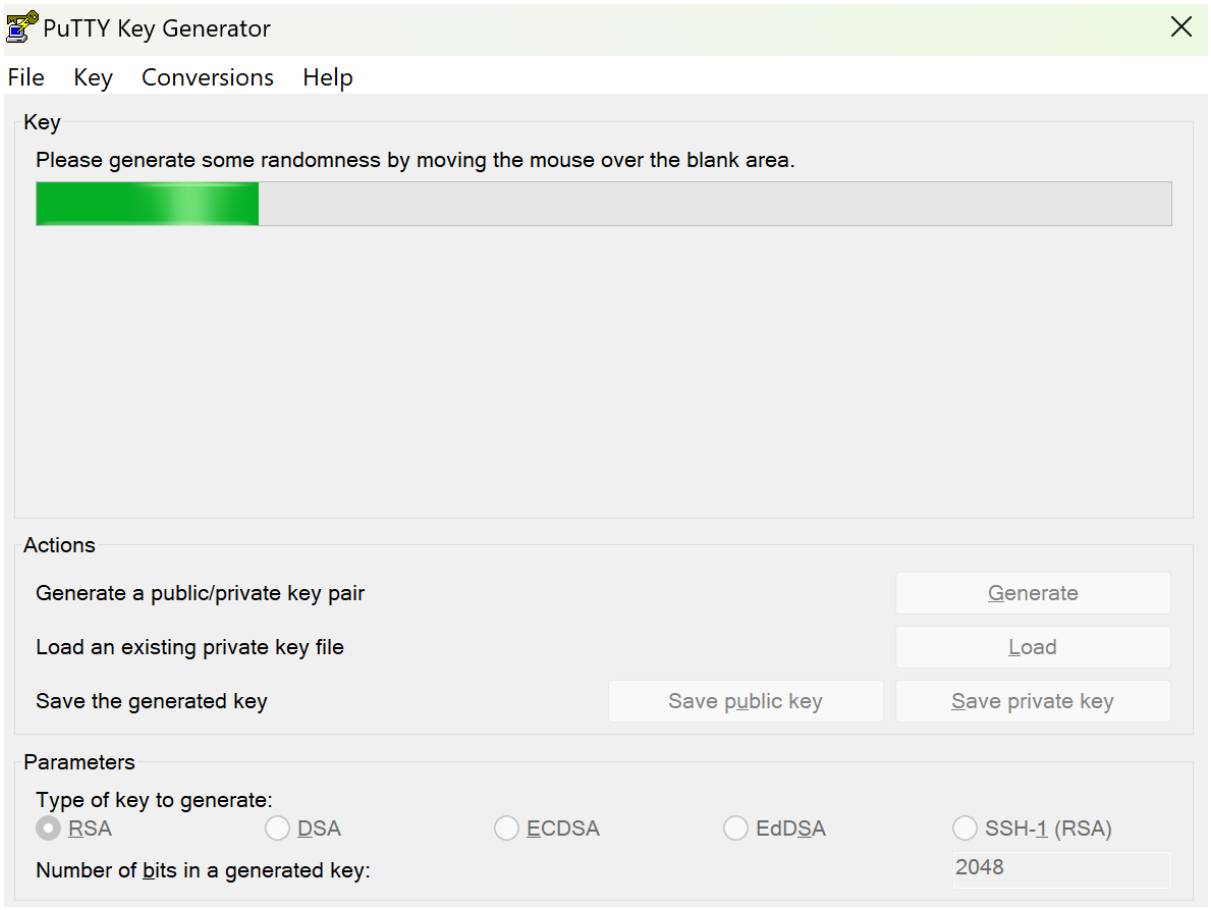
Color Code	Color
0;30	Black
0;31	Red
0;32	Green
0;33	Brown
0;34	Blue
0;35	Purple
0;36	Cyan
0;37	White

SETUP KEYPAIR FOR WEEWX TO LOGIN WITHOUT A PASSWORD.

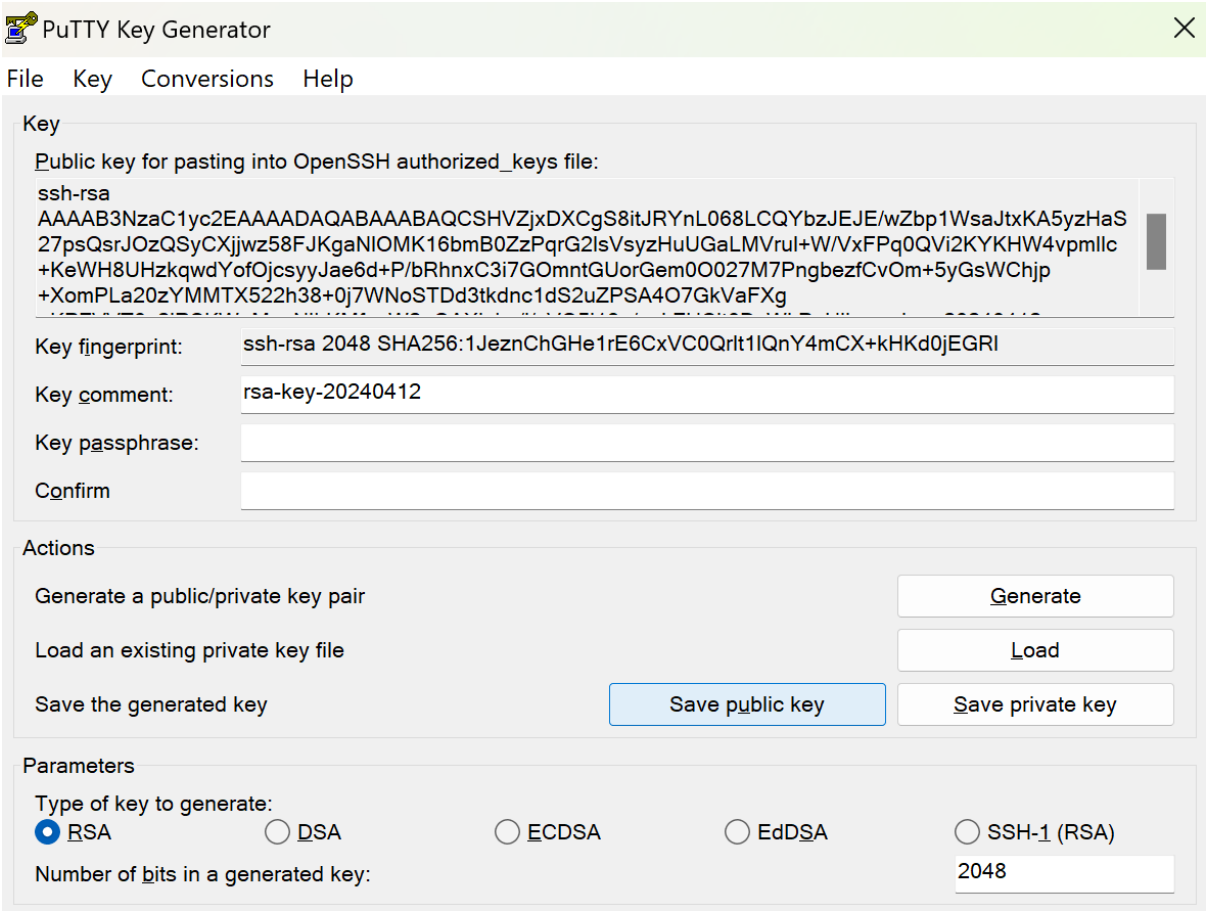
Use Puttygen to generate the keypair



Click on “Generate”



Move your mouse randomly inside the box.



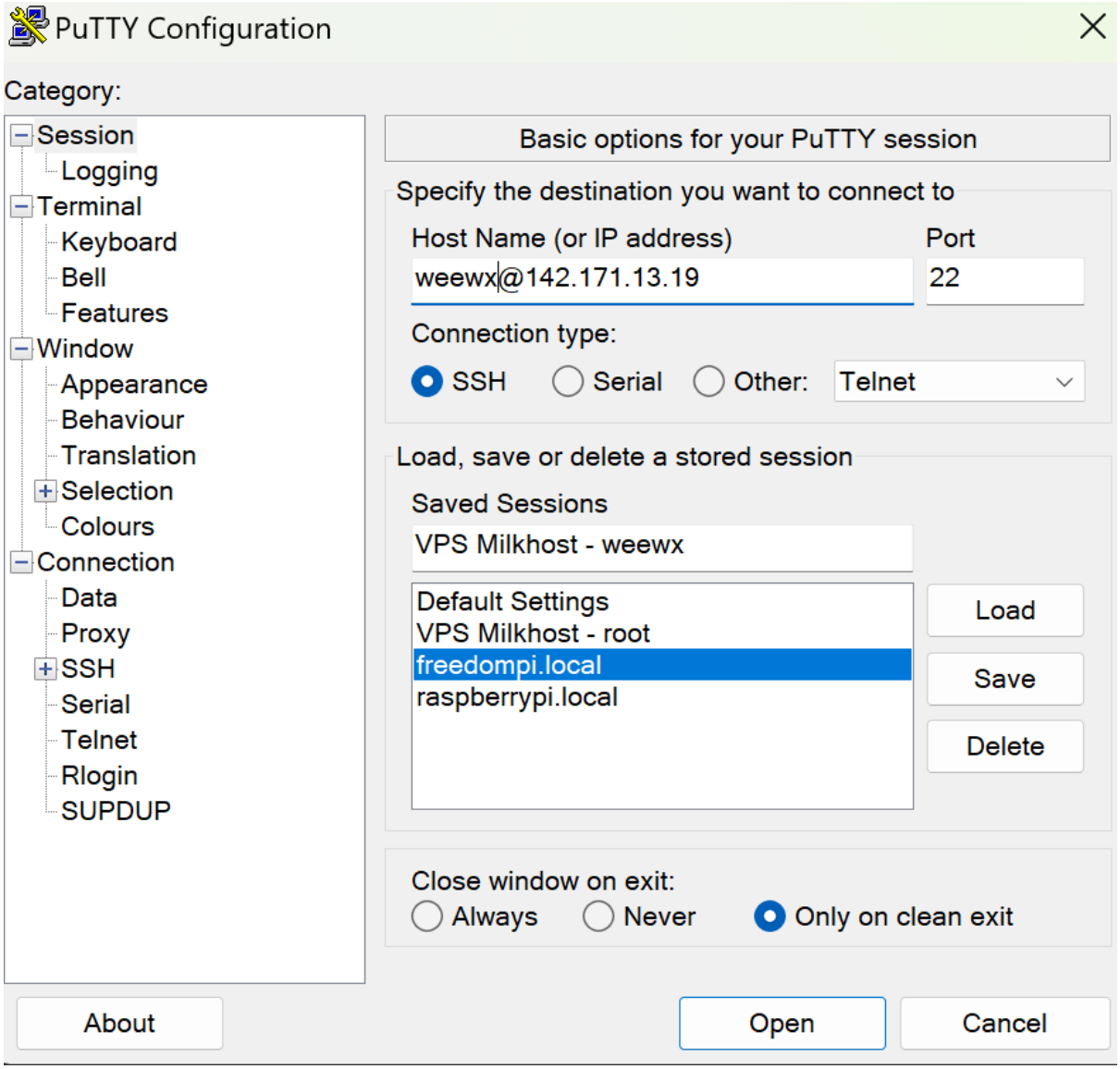
Save the public and private keys to a file in a secure location.

Copy the public key to the server.

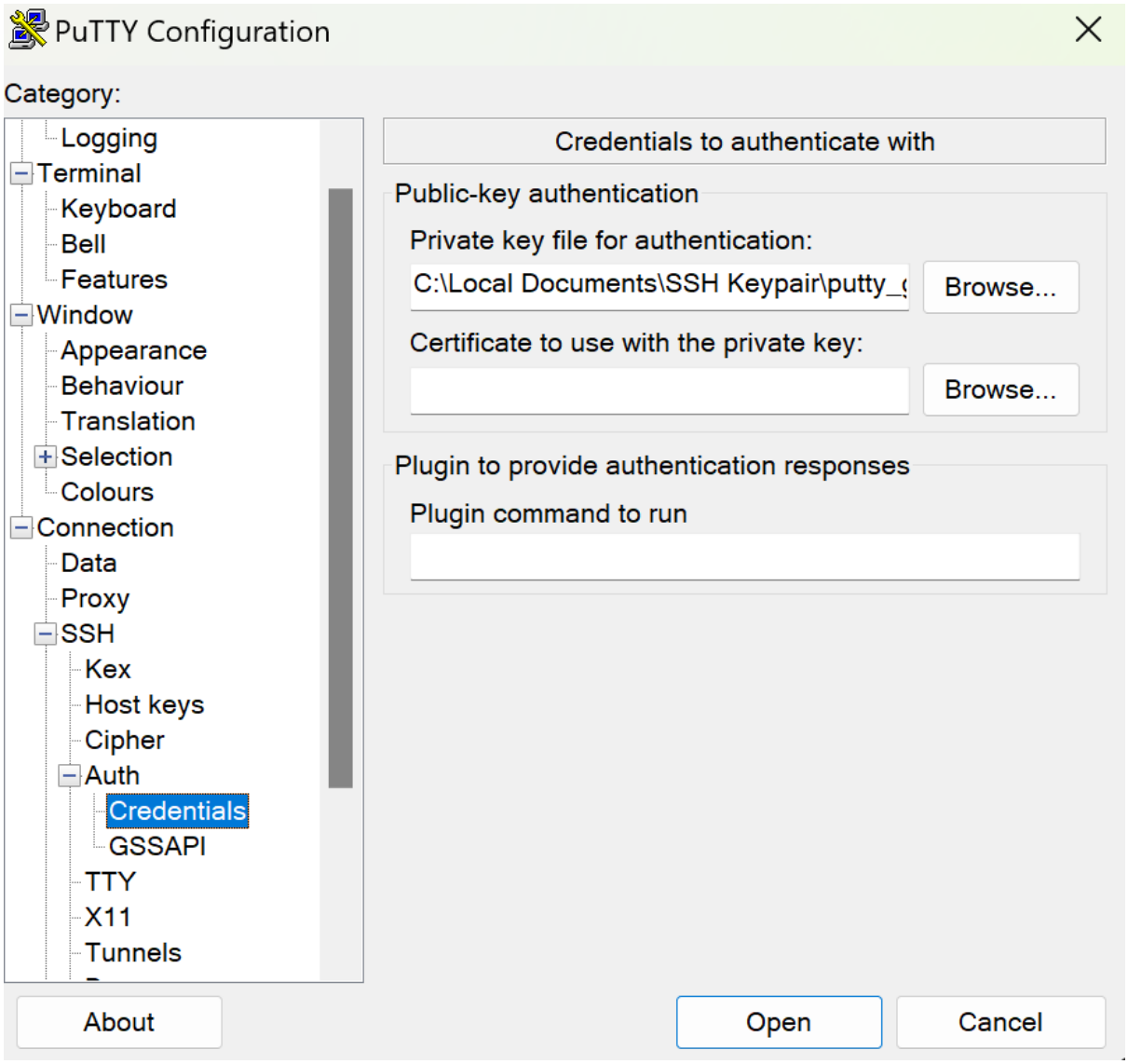
Login as weewx

```
[weewx@cloud009 ~]$ cd ~
[weewx@cloud009 ~]$ mkdir .ssh
[weewx@cloud009 ~]$ cd .ssh
[weewx@cloud009 ~/.ssh]$ vi authorized_keys
```

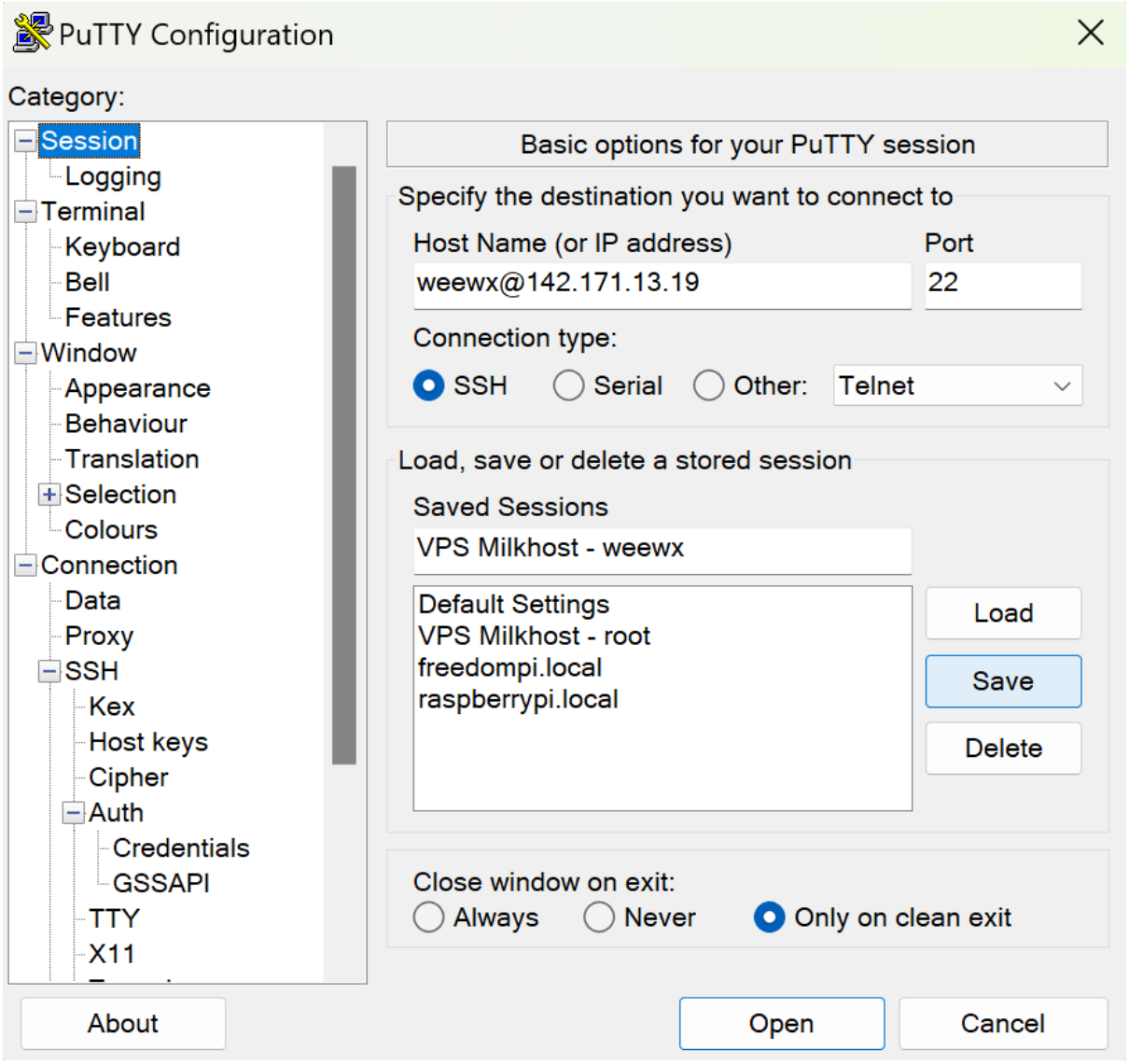
```
Copy the public key generated
```



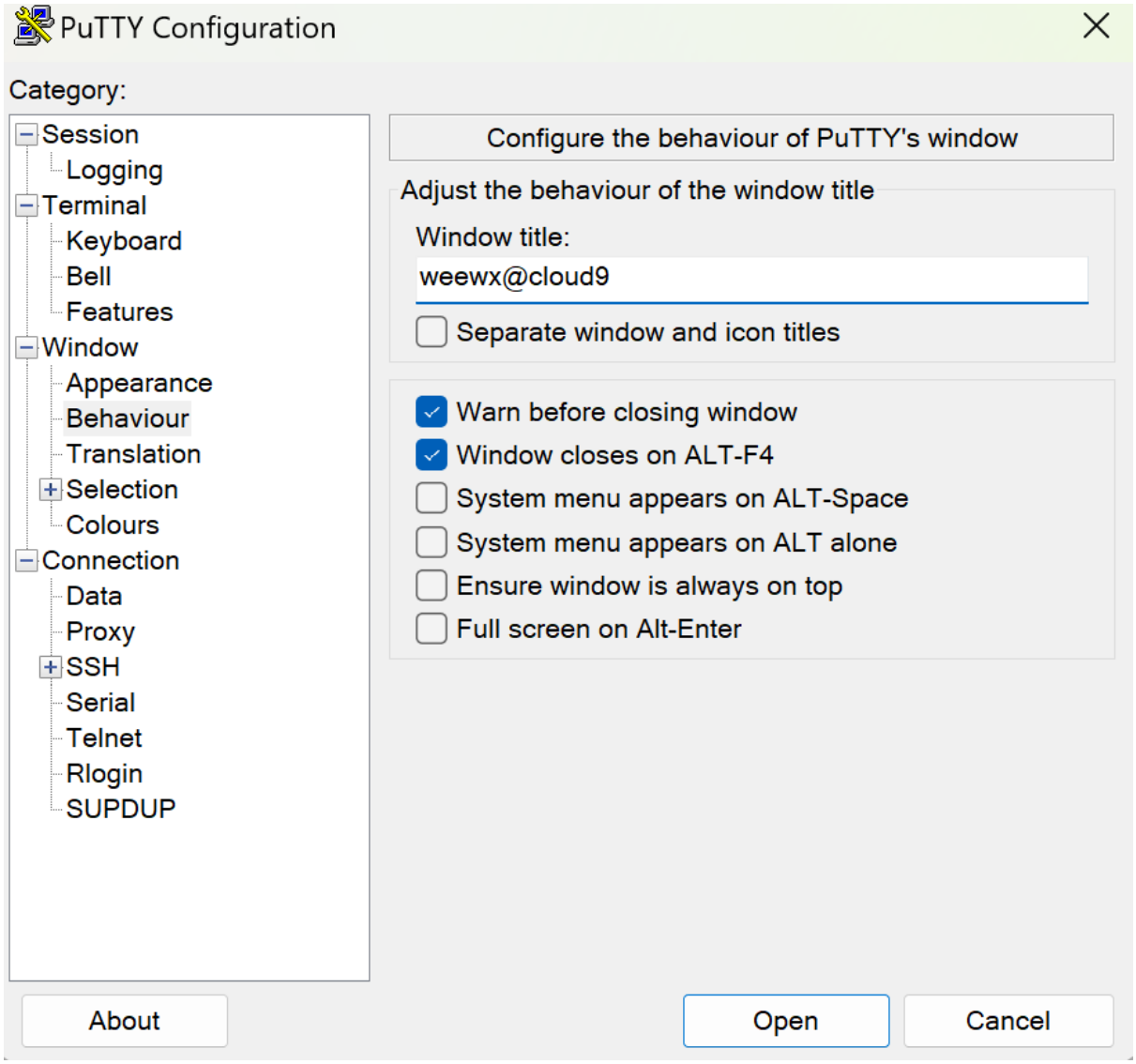
Create a session in putty



Pass the private key file


PuTTY Configuration
Category:
Session
Logging
Terminal
Keyboard
Bell
Features
Window
Appearance
Behaviour
Translation
Selection
Colours
Connection
Data
Proxy
SSH
Kex
Host keys
Cipher
Auth
Credentials
GSSAPI
TTY
X11
Basic options for your PuTTY session
Specify the destination you want to connect to
Host Name (or IP address)
Port
weewx@142.171.13.19
22
Connection type:
SSH
Serial
Other:
Telnet
Load, save or delete a stored session
Saved Sessions
VPS Milkhost - weewx
Default Settings
VPS Milkhost - root
freedompi.local
raspberrypi.local
Load
Save
Delete
Close window on exit:
Always
Never
Only on clean exit
About
Open
Cancel

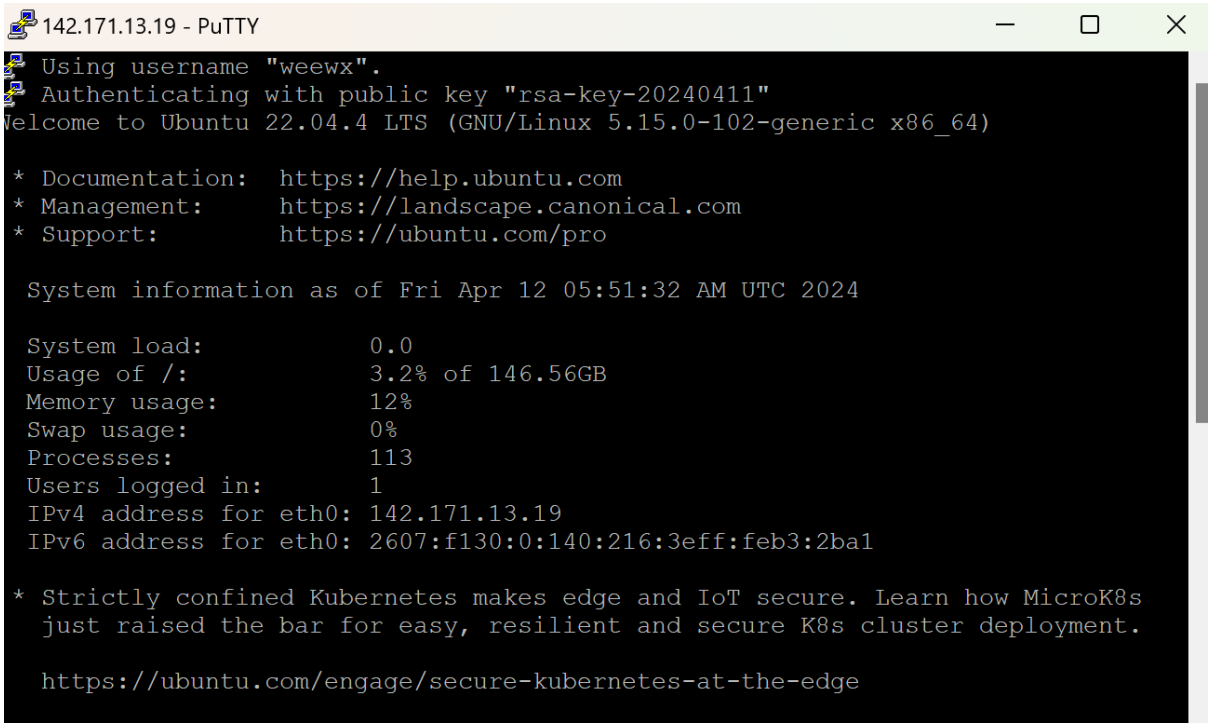
Save



Change the title of the session to show the username and hostname

[How can I set PuTTY's window title to the name of the loaded session? - Server Fault]

Test logging in



ADD WEEWX TO SUDO

Source: How To Create A New Sudo Enabled User on Ubuntu | DigitalOcean

```
[weewx@cloud009 ~]$ groups
```

```
weewx
```

```
root@cloud009:~# usermod -aG sudo weewx
root@cloud009:~# su - weewx
```

```
To run a command as administrator (user "root"), use "sudo <command>".
See "man sudo_root" for details.
```

```
[weewx@cloud009 ~]$ groups
```

```
weewx sudo
```

INSTALL APACHE WEB SERVER

Source: How To Install the Apache Web Server on Ubuntu | DigitalOcean

STEP 1 — INSTALLING APACHE

Apache is available within Ubuntu's default software repositories, making it possible to install it using conventional package management tools.

Begin by updating the local package index to reflect the latest upstream changes. Then, install the apache2 package:

```
[weewx@cloud009 ~]$ sudo apt update
[weewx@cloud009 ~]$ sudo apt install apache2
```

STEP 2 — ADJUSTING THE FIREWALL

Before testing Apache, it's necessary to modify the firewall settings to allow outside access to the default web ports. If you followed the instructions in the prerequisites, you should have a UFW firewall configured to restrict access to your server.

During installation, Apache registers itself with UFW to provide a few application profiles that can be used to enable or disable access to Apache through the firewall.

List the ufw application profiles by running the following:

```
[weewx@cloud009 ~]$ sudo ufw app list
```

```
Available applications:
  Apache
  Apache Full
  Apache Secure
  OpenSSH
```

As indicated by the output, there are three profiles available for Apache:

- Apache: This profile opens only port 80 (normal, unencrypted web traffic)
- Apache Full: This profile opens both port 80 (normal, unencrypted web traffic) and port 443 (TLS/SSL encrypted traffic)
- Apache Secure: This profile opens only port 443 (TLS/SSL encrypted traffic)

Allow on HTTP and HTTPS

```
[weewx@cloud009 ~]$ sudo ufw allow 'Apache Full'
```

```
Rules updated
Rules updated (v6)
```

Firewall isn't active

```
[weewx@cloud009 ~]$ sudo ufw status
```

```
Status: inactive
```

STEP 3 — CHECKING YOUR WEB SERVER

At the end of the installation process, Ubuntu starts Apache. The web server will already be up and running.

Make sure the service is active by running the command for the systemd init system:

```
[weewx@cloud009 ~]$ sudo systemctl status apache2
```

```
● apache2.service - The Apache HTTP Server
     Loaded: loaded (/lib/systemd/system/apache2.service; enabled; vendor
preset: enabled)
     Active: active (running) since Fri 2024-04-12 06:06:06 UTC; 3min 12s
ago
       Docs: https://httpd.apache.org/docs/2.4/
   Main PID: 9806 (apache2)
      Tasks: 55 (limit: 2220)
     Memory: 5.0M
        CPU: 59ms
     CGroup: /system.slice/apache2.service
             ├─9806 /usr/sbin/apache2 -k start
             ├─9807 /usr/sbin/apache2 -k start
             └─9808 /usr/sbin/apache2 -k start

Apr 12 06:06:06 cloud009.annaiservers.com systemd[1]: Starting The Apache
HTTP Server...
Apr 12 06:06:06 cloud009.annaiservers.com apachectl[9805]: AH00558:
apache2: Could not reliably determine the server's fully qualified domain
name, using cloud009.annaiservers.>
Apr 12 06:06:06 cloud009.annaiservers.com systemd[1]: Started The Apache
HTTP Server.
```

Test the page http://142.171.13.19

This is the default welcome page used to test the correct operation of the Apache2 server after installation on Ubuntu systems. It is based on the equivalent page on Debian, from which the Ubuntu Apache packaging is derived. If you can read this page, it means that the Apache HTTP server installed at this site is working properly. You should **replace this file** (located at `/var/www/html/index.html`) before continuing to operate your HTTP server.

If you are a normal user of this web site and don't know what this page is about, this probably means that the site is currently unavailable due to maintenance. If the problem persists, please contact the site's administrator.

Configuration Overview

Ubuntu's Apache2 default configuration is different from the upstream default configuration, and split into several files optimized for interaction with Ubuntu tools. The configuration system is **fully documented in /usr/share/doc/apache2/README.Debian.gz**. Refer to this for the full documentation. Documentation for the web server itself can be found by accessing the **manual** if the `apache2-doc` package was installed on this server.

The configuration layout for an Apache2 web server installation on Ubuntu systems is as follows:

```
/etc/apache2/
|-- apache2.conf
|       `--  ports.conf
|-- mods-enabled
|       |-- *.load
|       `-- *.conf
|-- conf-enabled
|       `-- *.conf
|-- sites-enabled
|       `-- *.conf
```

- `apache2.conf` is the main configuration file. It puts the pieces together by including all remaining configuration files when starting up the web server.

STEP 4 — MANAGING THE APACHE PROCESS

Now that you have your web server up and running, let’s review some basic management commands using systemctl.

To stop, start and restart your web server, run:

```
sudo systemctl stop apache2
sudo systemctl start apache2
sudo systemctl restart apache2
```

If you are simply making configuration changes, Apache can often reload without dropping connections. To do this, use the following command:

```
sudo systemctl reload apache2
```

By default, Apache is configured to start automatically when the server boots. If this is not what you want, disable this behavior by running: (Next command is to enable)

```
sudo systemctl disable apache2
sudo systemctl enable apache2
```

SETUP THE DOMAIN NAME TO POINT TO THE SERVER

Source: How to Point a Domain Name to VPS (hostinger.in)

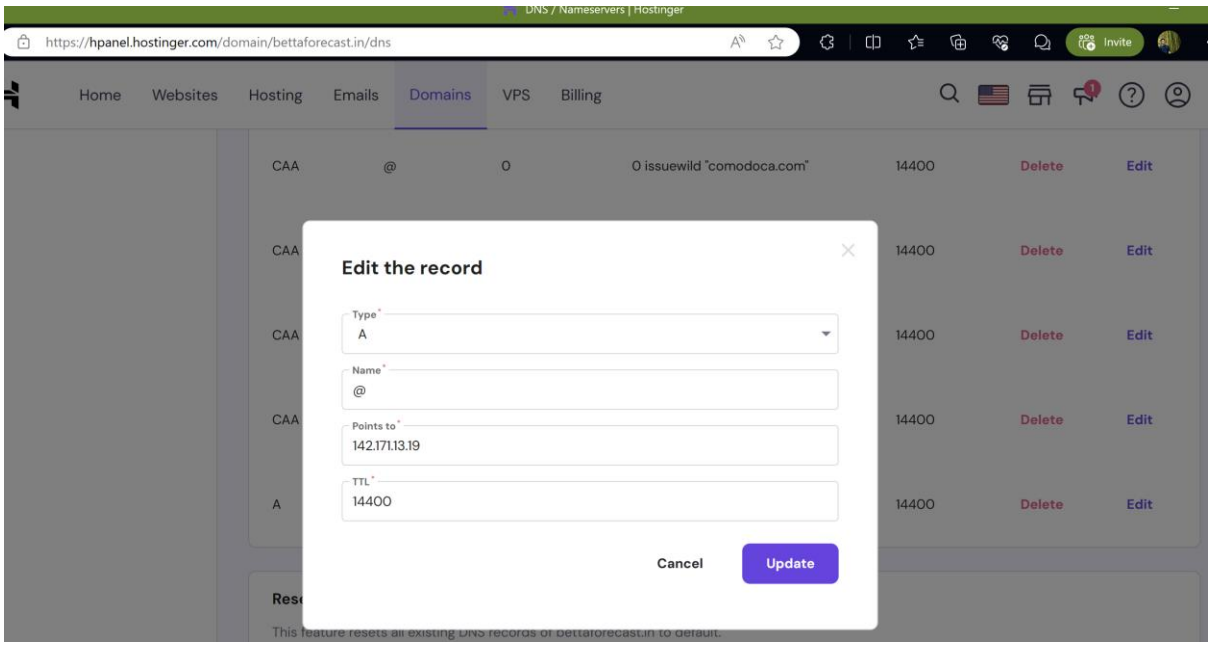
I have purchased a domain called bettaforecast.in from Hostinger

To use a custom domain name with a virtual private server (VPS), you must make a few DNS changes. Otherwise, your website will become inaccessible since the DNS server can't resolve your domain into its IP address.

In this tutorial, we'll show you how to point a domain name to VPS using three methods – changing the A record, configuring Cloudflare, or using custom nameservers.

If you purchased the domain from Hostinger, you can easily change the DNS record entries via hPanel:

1. Navigate to **hPanel** → **Domains** and select the domain in question.
2. Click **DNS/Nameserver** on the sidebar.
3. In the **DNS record** tab, go to the **Manage DNS records** section.
4. Find an existing **A and CNAME record** type in the DNS zone and replace their value with your VPS **IP address**.



You can test by clicking on intoDNS: bettaforecast.in - check DNS server and mail server health

Category	Status	Test name	Information
Parent		Domain NS records	Nameserver records returned by the parent servers are: ns1.dns-parking.com. ['162.159.24.201'] (NO GLUE) [TTL=3600] ns2.dns-parking.com. ['162.159.25.42'] (NO GLUE) [TTL=3600] **ns1.registry.in** was kind enough to give us that information.
		TLD Parent Check	Good. ns1.registry.in, the parent server I interrogated, has information for your TLD. This is a good thing as there are some other domain extensions like "co.us" for example that are missing a direct check.
		Your nameservers are listed	Good. The parent server ns1.registry.in has your nameservers listed. This is a must if you want to be found as anyone that does not know your DNS servers will first ask the parent nameservers.
		DNS Parent sent Glue	The parent nameserver ns1.registry.in is not sending out GLUE for every nameservers listed, meaning he is sending out your nameservers host names without sending the A records of those nameservers. It's ok but you have to know that this will require an extra A lookup that can delay a little the connections to your site. This happens a lot if you have nameservers on different TLD (domain.com for example with nameserver ns.domain.org.)
		Nameservers A records	Good. Every nameserver listed has A records. This is a must if you want to be found.
NS		NS records from your nameservers	NS records got from your nameservers listed at the parent NS are: ns2.dns-parking.com ['162.159.25.42'] [TTL=86400] ns1.dns-parking.com ['162.159.24.201'] [TTL=86400]
		Recursive Queries	Good. Your nameservers (the ones reported by the parent server) do not report that they allow recursive queries for anyone.
		Same Glue	The A records (the GLUE) got from the parent zone check are the same as the ones got from your nameservers. You have to make sure your parent server has the same NS records for your zone as you do according to the RFC. This tests only nameservers that are common at the parent and at your nameservers. If there are any missing or stealth nameservers you should see them below!
		Glue for NS records	INFO: GLUE was not sent when I asked your nameservers for your NS records.This is ok but you should know that in this case an extra A record lookup is required in order to get the IPs of your NS records. The nameservers without glue are:

STEP 5 — SETTING UP VIRTUAL HOSTS (RECOMMENDED)

I'm setting up apache on a remote server to display reports.

When using the Apache web server, you can use *virtual hosts* (similar to server blocks in Nginx) to encapsulate configuration details and host more than one domain from a single server. We will set up a domain called **bettaforecast**.

Apache on Ubuntu has one server block enabled by default that is configured to serve documents from the /var/www/html directory. While this works well for a single site, it can become unwieldy if you are hosting multiple sites. Instead of modifying /var/www/html, create a directory structure within /var/www for a **bettaforecast** site, leaving /var/www/html in place as the default directory to be served if a client request doesn't match any other sites.

The permissions of your web root should be correct if you haven't modified your umask value, which sets default file permissions. To ensure that your permissions are correct and allow the owner to read, write, and execute the files while granting only read and execute permissions to groups and others, you can input the following command:

```
[weewx@cloud009 ~]$ sudo mkdir /var/www/bettaforecast
[weewx@cloud009 ~]$ sudo chown -R $USER:$USER /var/www/bettaforecast/
[weewx@cloud009 ~]$ sudo chmod -R 755 /var/www/bettaforecast/
```

```
Next, create a sample index.html page
```

```
[weewx@cloud009 ~]$ sudo vi /var/www/bettaforecast/index.html
```

```
<html>
    <head>
        <title>Welcome to Betta Forecast!</title>
    </head>
    <body>
        <h1>Success!  The bettaforecast virtual host is working!</h1>
    </body>
</html>
```

In order for Apache to serve this content, it's necessary to create a virtual host file with the correct directives. Instead of modifying the default configuration file located at /etc/apache2/sites-available/000-default.conf directly, make a new one at /etc/apache2/sites-available/bettaforecast.conf:

```
[weewx@cloud009 ~]$ sudo vi /etc/apache2/sites-available/bettaforecast.conf
```

```
<VirtualHost *:80>
    ServerAdmin vrishabkakade@gmail.com
    ServerName bettaforecast.in
    ServerAlias www.bettaforecast
    DocumentRoot /var/www/bettaforecast
    ErrorLog ${APACHE_LOG_DIR}/error.log
    CustomLog ${APACHE_LOG_DIR}/access.log combined
</VirtualHost>
```

Notice that we've updated the DocumentRoot to our new directory and ServerAdmin to an email that the **bettaforecast** site administrator can access. We've also added two directives: ServerName, which establishes the base domain that will match this virtual host definition, and ServerAlias, which defines further names that will match as if they were the base name.

Save and close the file when you are finished.

Now enable the file with the a2ensite tool:

```
[weewx@cloud009 ~]$ sudo a2ensite bettaforecbettaforecast.conf
```

```
Enabling site bettaforecast.
To activate the new configuration, you need to run:
  systemctl reload apache2
```

Disable the default site defined in 000-default.conf:

```
[weewx@cloud009 ~]$ sudo a2dissite 000-default.conf
```

```
Site 000-default disabled.
To activate the new configuration, you need to run:
  systemctl reload apache2
```

Next, test for configuration errors:

```
[weewx@cloud009 ~]$ sudo apache2ctl configtest
```

```
AH00558: apache2: Could not reliably determine the server's fully qualified
domain name, using cloud009.annaiservers.com. Set the 'ServerName'
directive globally to suppress this message
Syntax OK
```

Restart Apache to implement your changes:

```
[weewx@cloud009 ~]$ sudo systemctl restart apache2
```

STEP 6 – GETTING FAMILIAR WITH IMPORTANT APACHE FILES AND DIRECTORIES

Now that you know how to manage the Apache service itself, you should take a few minutes to familiarize yourself with a few important directories and files.

CONTENT

- `/var/www/html`: The actual web content, which by default only consists of the default Apache page you saw earlier, is served out of the `/var/www/html` directory. This can be changed by altering Apache configuration files.

SERVER CONFIGURATION

- `/etc/apache2`: The Apache configuration directory. All of the Apache configuration files reside here.
- `/etc/apache2/apache2.conf`: The main Apache configuration file. This can be modified to make changes to the Apache global configuration. This file is responsible for loading many of the other files in the configuration directory.
- `/etc/apache2/ports.conf`: This file specifies the ports that Apache will listen on. By default, Apache listens on port `80` and additionally listens on port `443` when a module providing SSL capabilities is enabled.
- `/etc/apache2/sites-available/`: The directory where per-site virtual hosts can be stored. Apache will not use the configuration files found in this directory unless they are linked to the `sites-enabled` directory. Typically, all server block configuration is done in this directory and then enabled by linking to the other directory with the `a2ensite` command.
- `/etc/apache2/sites-enabled/`: The directory where enabled per-site virtual hosts are stored. Typically, these are created by linking to configuration files found in the `sites-available` directory with the `a2ensite`. Apache reads the configuration files and links found in this directory when it starts or reloads to compile a complete configuration.
- `/etc/apache2/conf-available/`, `/etc/apache2/conf-enabled/`: These directories have the same relationship as the `sites-available` and `sites-enabled` directories but are used to store configuration fragments that do not belong in a virtual host. Files in the `conf-available` directory can be enabled with the `a2enconf` command and disabled with the `a2disconf` command.
- `/etc/apache2/mods-available/`, `/etc/apache2/mods-enabled/`: These directories contain the available and enabled modules, respectively. Files ending in `.load` contain fragments to load specific modules, while files ending in `.conf` contain the configuration for those modules. Modules can be enabled and disabled using the `a2enmod` and `a2dismod` commands.

SERVER LOGS

- `/var/log/apache2/access.log`: By default, every request to your web server is recorded in this log file unless Apache is configured to do otherwise.
- `/var/log/apache2/error.log`: By default, all errors are recorded in this file. The `LogLevel` directive in the Apache configuration specifies how much detail the error logs will contain.

SETUP THE WEATHER STATION TO DISPLAY DATA TO THE INTERNET

So far the weather station has only been accessible from the LAN. Now it is time to set up the connectivity to the webserver we created in the previous section.

SETUP RSYNC FROM WEEWX TO WEBSERVER

Source: [StdReport] - WeeWX 5.0

While this "report" does not actually generate anything, it uses the report machinery to upload files from directory **HTML_ROOT** to a remote webserver using rsync. Fast, efficient, and secure, it does an incremental update, that is, it only synchronizes those parts of a file that have changed, saving the outgoing bandwidth of your Internet connection.

If you wish to use rsync, you must configure passwordless ssh using public/private key authentication from the user account that WeeWX runs, to the user account on the remote machine where the files will be copied.

enable

Set to **true** (the default) to enable rsync. Set to **false** to disable.

server

Set to the name of your server. This name should appear in your **.ssh/config** file. Required. No default

user

Set to the ssh username you use for your rsync connection to your web server. The local user that WeeWX runs as must have passwordless ssh configured for *user@server*. Required. No default.

path

Set to the path where the weather data will be stored on your webserver (*e.g.*, **/var/www/html/weather**). Make sure **user** has write privileges in this directory. Required. No default.

port

The port to use for the ssh connection. Default is to use the default port for the **ssh** command (generally 22).

delete

Files that don't exist in the local report are removed from the remote location.

Warning

USE WITH CAUTION! If you make a mistake in setting the path, this can cause unexpected files to be deleted on the remote server.

Valid values are **1** to enable and **0** to disable. Required. Default is **0**.

SETUP PASSWORDLESS SSH

The weather station Raspberry Pi needs to login without a password to the webserver. I will set it up for root as I run Weewx as root. I couldn't get it to run as non-root user even though it is supported.

```
vrishabkakade@freedompi.local:~/.ssh$ sudo su
root@freedompi:/home/vrishabkakade/.ssh# cd ~
root@freedompi:~# ls -lrat
```

```
total 40
-rw-r--r--  1 root root  161 Jul  9  2019 .profile
-rw-r--r--  1 root root  571 Apr 11  2021 .bashrc
drwx------  2 root root 4096 Mar 15 20:29 .ssh
drwx------  3 root root 4096 Mar 15 20:47 .vnc
drwx------  3 root root 4096 Apr  1 19:20 .cache
-rw-------  1 root root 2143 Apr  4 21:01 .mysql_history
-rw-r--r--  1 root root  180 Apr  5 18:42 .wget-hsts
drwxr-xr-x 18 root root 4096 Apr  9 20:48 ..
-rw-------  1 root root   20 Apr  9 20:48 .lesshst
drwx------  5 root root 4096 Apr  9 20:48 .
```

```
root@freedompi:~# cd .ssh
root@freedompi:~/.ssh# vi config
```

```
Host bettaforecat.in
    HostName bettaforecast.in
    User weewx
    IdentityFile ~/.ssh/id_rsa
```

```
root@freedompi:~/.ssh# chmod 600 ~/.ssh/config
```

```
root@freedompi:~/.ssh# ssh-keygen
```

```
Generating public/private rsa key pair.
Enter file in which to save the key (/root/.ssh/id_rsa):
Enter passphrase (empty for no passphrase):
Enter same passphrase again:
Your identification has been saved in /root/.ssh/id_rsa
Your public key has been saved in /root/.ssh/id_rsa.pub
```

Login to bettaforecast.in

On remote server, add the public key

```
[weewx@cloud009 /var/www/bettaforecast]$ cd
[weewx@cloud009 ~]$ cd .ssh/
```

```
[weewx@cloud009 ~/.ssh]$ vi authorized_keys
```

```
Add the public key
```

ENABLE RSYNC

Back on the Raspberry Pi

```
vrishabkakade@freedompi:~ $ cd /etc/weewx/
vrishabkakade@freedompi:/etc/weewx $ cp weewx.conf weewx.conf.`date +%Y%m%d`
```

```
Under [StdReport]

    [[RSYNC]]
        # rsync'ing to a webserver is treated as just another report.
        skin = Rsync

        # If you wish to use rsync, you must configure passwordless ssh
using
        # public/private key authentication from the user account that
weewx
        # runs to the user account on the remote machine where the files
        # will be copied.
        #
        # If you wish to use rsync, set "enable" to "true", then
        # fill out server, user, and path.
        # The server should appear in your .ssh/config file.
        # The user is the username used in the identity file.
        # The path is the destination directory, such as
/var/www/html/weather.
        # Be sure that the user has write permissions on the destination!
        enable = true
        server = bettaforecast.in
        user = weewx
        path = /var/www/bettaforecast

        # To upload files from something other than what HTML_ROOT is set
        # to above, specify a different HTML_ROOT here.
        #HTML_ROOT = /var/www/html/weewx

        # Rsync can be configured to remove files from the remote server if
        # they don't exist under HTML_ROOT locally. USE WITH CAUTION: if
you
        # make a mistake in the remote path, you could could
unintentionally
        # cause unrelated files to be deleted. Set to 1 to enable remote
file
        # deletion, zero to allow files to accumulate remotely.
        delete = 0
```

```
vrishabkakade@freedompi:/etc/weewx $ sudo systemctl restart weewx
vrishabkakade@freedompi:/etc/weewx $ sudo systemctl status weewx
```

```
● weewx.service - WeeWX
     Loaded: loaded (/lib/systemd/system/weewx.service; enabled; preset:
enabled)
     Active: active (running) since Fri 2024-04-12 16:09:48 IST; 5s ago
       Docs: https://weewx.com/docs
   Main PID: 16834 (python3)
      Tasks: 10 (limit: 4444)
        CPU: 470ms
     CGroup: /system.slice/weewx.service
             └─16834 python3 /usr/share/weewx/weewxd.py
/etc/weewx/weewx.conf

Apr 12 16:09:48 freedompi weewxd[16834]: INFO weewx.restx: WOW: Data for
station 00ef03c0-7cf6-ee11-a81c-0022489bcb24 will be posted
Apr 12 16:09:48 freedompi weewxd[16834]: INFO weewx.restx: AWEKAS: Posting
not enabled.
Apr 12 16:09:48 freedompi weewxd[16834]: INFO user.windy: version is 0.7
Apr 12 16:09:48 freedompi weewxd[16834]: INFO user.windy: Data will be
uploaded to https://stations.windy.com/pws/update
Apr 12 16:09:48 freedompi weewxd[16834]: INFO weewx.engine: 'pyephem'
detected, extended almanac data is available
Apr 12 16:09:48 freedompi weewxd[16834]: INFO __main__: Starting up weewx
version 5.0.2
Apr 12 16:09:48 freedompi weewxd[16834]: INFO weewx.engine: Using binding
'wx_binding' to database 'weewx.sdb'
Apr 12 16:09:48 freedompi weewxd[16834]: INFO weewx.manager: Starting
backfill of daily summaries
Apr 12 16:09:48 freedompi weewxd[16834]: INFO weewx.manager: Daily
summaries up to date
Apr 12 16:09:48 freedompi weewxd[16834]: INFO weewx.engine: Starting main
packet loop.
```

🔒 ADD SSL TO THE WEBSERVER

Source: How To Secure Apache with Let's Encrypt on Ubuntu | DigitalOcean

Back on the webserver bettaforecast.in

Let's Encrypt is a Certificate Authority (CA) that facilitates obtaining and installing free TLS/SSL certificates, thereby enabling encrypted HTTPS on web servers. It streamlines the process by providing a software client, Certbot, that attempts to automate most (if not all) of the required steps. Currently, the entire process of obtaining and installing a certificate is fully automated on both Apache and Nginx.

In this guide, you'll use Certbot to obtain a free SSL certificate for Apache on Ubuntu and make sure this certificate is set up to renew automatically.

This tutorial uses a separate virtual host file instead of Apache's default configuration file for setting up the website that will be secured by Let's Encrypt. We recommend creating new Apache virtual host files for each domain hosted in a server because it helps to avoid common mistakes and maintains the default configuration files as a fallback setup.

❗ PREREQUISITE

To follow this tutorial, you will need:

- One Ubuntu server set up with a non-*root* user with sudo administrative privileges and firewall enabled. You can set this up by following our initial server setup for Ubuntu tutorial.
- A fully registered domain name. This tutorial will use **your_domain** as an example throughout. You can purchase a domain name on Namecheap, get one for free on Freenom, or use the domain registrar of your choice.
- Both of the following DNS records set up for your server. You can follow this introduction to DigitalOcean DNS for details on how to add them.
    - An A record with your_domain pointing to your server's public IP address.
    - An A record with www.your_domain pointing to your server's public IP address.
- Apache installed by following How To Install Apache on Ubuntu. Be sure that you have a virtual host file for your domain. This tutorial will use /etc/apache2/sites-available/your_domain.conf as an example.

🎖 STEP 1 — INSTALLING CERTBOT

To obtain an SSL certificate with Let's Encrypt, you need to install the Certbot software on your server. You'll use the default Ubuntu package repositories for that.

```
[weewx@cloud009 ~]$ sudo apt update
[weewx@cloud009 ~]$ sudo apt isudo apt install certbot python3-certbot-apache
```

Certbot is now installed on your server. In the next step, you'll verify Apache's configuration to make sure your virtual host is set appropriately. This will ensure that the certbot client script will be able to detect your domains and reconfigure your web server to use your newly generated SSL certificate automatically.

STEP 2 — CHECKING YOUR APACHE VIRTUAL HOST CONFIGURATION

To automatically obtain and configure SSL for your web server, Certbot needs to find the correct virtual host within your Apache configuration files. Your server domain name(s) will be retrieved from the ServerName and ServerAlias directives defined within your VirtualHost configuration block.

If you followed the virtual host setup step in the Apache installation tutorial, you should have a VirtualHost block set up for your domain at /etc/apache2/sites-available/bettaforecast.conf with the ServerName and also the ServerAlias directives already set appropriately.

```
[weewx@cloud009 ~]$ sudo apache2ctl configtest
```

```
AH00558: apache2: Could not reliably determine the server's fully qualified
domain name, using cloud009.annaiservers.com. Set the 'ServerName'
directive globally to suppress this message
Syntax OK
```

You should receive Syntax OK as a response. If you get an error, reopen the virtual host file and check for any typos or missing characters. Once your configuration file's syntax is correct, reload Apache so that the changes take effect:

```
[weewx@cloud009 ~]$ sudo systemctl reload apache2
```

With these changes, Certbot will be able to find the correct VirtualHost block and update it.

Next, you'll update the firewall to allow HTTPS traffic.

SKIP SETP 3 as no FIREWALL

STEP 4 — OBTAINING AN SSL CERTIFICATE

Certbot provides a variety of ways to obtain SSL certificates through plugins. The Apache plugin will take care of reconfiguring Apache and reloading the configuration whenever necessary. To use this plugin, run the following:

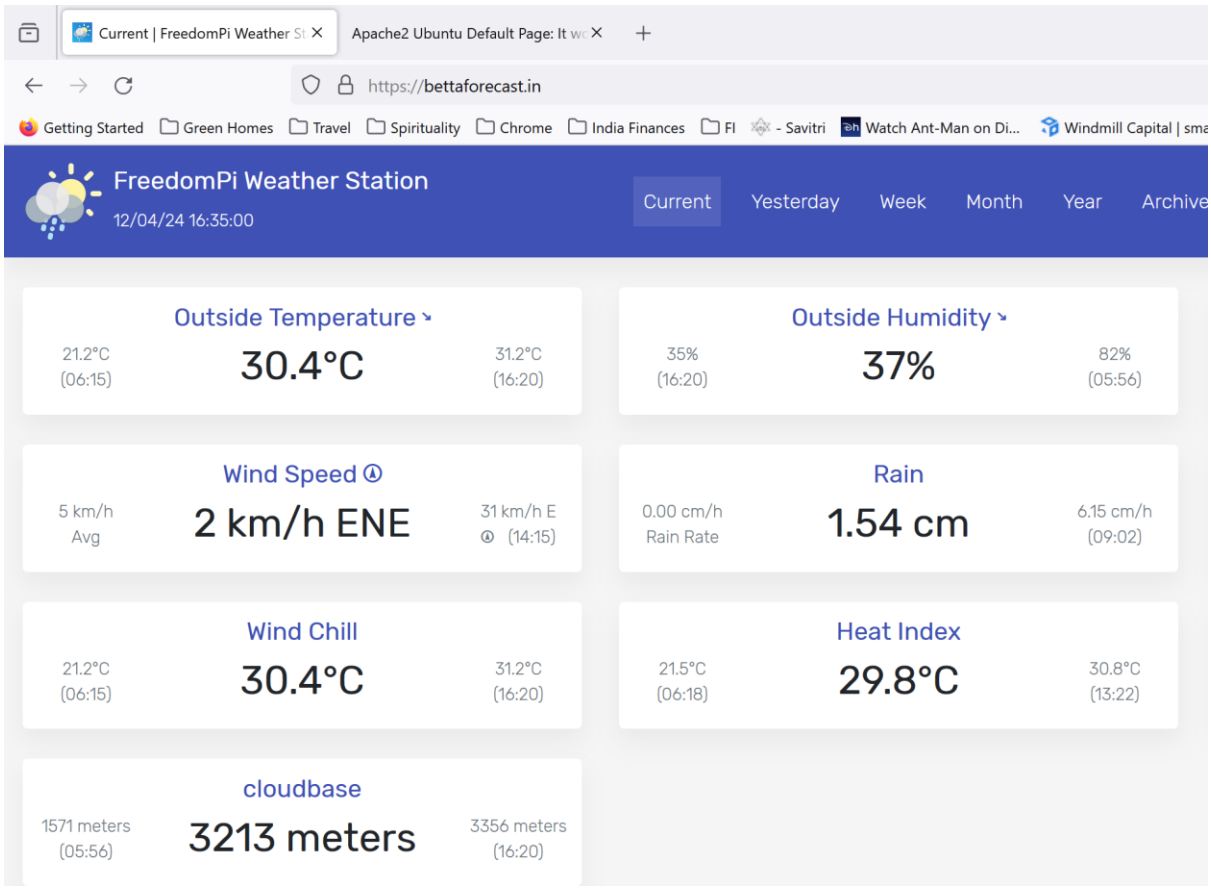
```
[weewx@cloud009 ~]$ sudo certbot -apache
```

```
Saving debug log to /var/log/letsencrypt/letsencrypt.log
Enter email address (used for urgent renewal and security notices)
 (Enter 'c' to cancel): vrishabkakade@gmail.com

- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
- -
Please read the Terms of Service at
https://letsencrypt.org/documents/LE-SA-v1.4-April-3-2024.pdf. You must
agree in
order to register with the ACME server. Do you agree?
- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
```

```
- -
(Y)es/(N)o: Y

- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
- -
Would you be willing, once your first certificate is successfully issued,
to
share your email address with the Electronic Frontier Foundation, a
founding
partner of the Let's Encrypt project and the non-profit organization that
develops Certbot? We'd like to send you email about our work encrypting the
web,
EFF news, campaigns, and ways to support digital freedom.
- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
- -
(Y)es/(N)o: N
Account registered.

Which names would you like to activate HTTPS for?
- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
- -
1: bettaforecast.in
2: www.bettaforecast
- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
- -
Select the appropriate numbers separated by commas and/or spaces, or leave
input
blank to select all options shown (Enter 'c' to cancel): 1
Requesting a certificate for bettaforecast.in

Successfully received certificate.
Certificate is saved at:
/etc/letsencrypt/live/bettaforecast.in/fullchain.pem
Key is saved at:         /etc/letsencrypt/live/bettaforecast.in/privkey.pem
This certificate expires on 2024-07-11.
These files will be updated when the certificate renews.
Certbot has set up a scheduled task to automatically renew this certificate
in the background.

Deploying certificate
Successfully deployed certificate for bettaforecast.in to
/etc/apache2/sites-available/bettaforecast-le-ssl.conf
Congratulations! You have successfully enabled HTTPS on
https://bettaforecast.in

- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
- -
If you like Certbot, please consider supporting our work by:
 * Donating to ISRG / Let's Encrypt:   https://letsencrypt.org/donate
 * Donating to EFF:                    https://eff.org/donate-le
- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
- -
```

Your certificate is now installed and loaded into Apache's configuration. Try reloading your website using https:// and notice your browser's security indicator. It should indicate that your site is properly secured, typically by a lock icon in the address bar.
You can use the SSL Labs Server Test to verify your certificate's grade and obtain detailed information about it, from the perspective of an external service.

In the next and final step, you'll test the auto-renewal feature of Certbot, which guarantees that your certificate will be renewed automatically before the expiration date.



STEP 5 — VERIFYING CERTBOT AUTO-RENEWAL

Let's Encrypt's certificates are only valid for ninety days. This is to encourage users to automate their certificate renewal process, as well as to ensure that misused certificates or stolen keys will expire sooner rather than later.

The certbot package you installed takes care of renewals by including a renew script to /etc/cron.d, which is managed by a systemctl service called certbot.timer. This script runs twice a day and will automatically renew any certificate that's within thirty days of expiration.

To check the status of this service and make sure it's active, run the following:

```
[weewx@cloud009 ~]$ sudo systesudo systemctl status certbot.timer
```

```
● certbot.timer - Run certbot twice daily
     Loaded: loaded (/lib/systemd/system/certbot.timer; enabled; vendor
preset: enabled)
     Active: active (waiting) since Fri 2024-04-12 10:55:33 UTC; 11min ago
    Trigger: Fri 2024-04-12 13:27:07 UTC; 2h 19min left
   Triggers: ● certbot.service

Apr 12 10:55:33 cloud009.annaiservers.com systemd[1]: Started Run certbot
twice daily.
```

To test the renewal process, you can do a dry run with certbot:

```
[weewx@cloud009 ~]$ sudo certbot renew --dry-run
```

```
Saving debug log to /var/log/letsencrypt/letsencrypt.log

- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
- -
Processing /etc/letsencrypt/renewal/bettaforecast.in.conf
- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
- -
Account registered.
Simulating renewal of an existing certificate for bettaforecast.in

- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
- -
Congratulations, all simulated renewals succeeded:
  /etc/letsencrypt/live/bettaforecast.in/fullchain.pem (success)
- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
- -
```

If you don't receive any errors, you're all set. When necessary, Certbot will renew your certificates and reload Apache to pick up the changes. If the automated renewal process ever fails, Let's Encrypt will send a message to the email you specified, warning you when your certificate is about to expire.

Other good docs (but not needed for my setup)

SETUP ANDROID APP (OPTIONAL)

Source: Home · evilbunny2008/weeWXWeatherApp Wiki · GitHub

STEP 1, INSTALL THE INIGO EXTENSION FOR WEEWX.

This has to be done on the Raspberry Pi as that is where Weewx is installed.

```
vrishabkakade@freedompi:~ $ cd /tmp
vrishabkakade@freedompi:/tmp $ wget -O inigo-metric.tar.gz
https://github.com/evilbunny2008/weeWXWeatherApp/releases/download/1.0.17/inigo-metric.tar.gz
vrishabkakade@freedompi:/tmp $ sudo weectl extension install inigo-metric.tar.gz
```

```
Using configuration file /etc/weewx/weewx.conf
Install extension 'inigo-metric.tar.gz' (y/n)? y
Extracting from tar archive inigo-metric.tar.gz
Saving installer file to /etc/weewx/bin/user/installer/Inigo
Saved copy of configuration as /etc/weewx/weewx.conf.20240412182619
Finished installing extension Inigo from inigo-metric.tar.gz
```

STEP 2, ALMANAC (OPTIONAL)

If you would like to see moon rise/set in the app, you just need to install pyephem.

```
sudo apt -y install python3-ephem
```

STEP 3, RESTARTING WEEWX

```
vrishabkakade@freedompi:/tmp $ sudo systemctl restart weewx
vrishabkakade@freedompi:/tmp $ sudo systemctl status weewx
```

```
● weewx.service - WeeWX
     Loaded: loaded (/lib/systemd/system/weewx.service; enabled; preset:
enabled)
     Active: active (running) since Fri 2024-04-12 18:28:42 IST; 7s ago
       Docs: https://weewx.com/docs
   Main PID: 17971 (python3)
      Tasks: 10 (limit: 4444)
        CPU: 502ms
     CGroup: /system.slice/weewx.service
             └─17971 python3 /usr/share/weewx/weewxd.py
/etc/weewx/weewx.conf

Apr 12 18:28:43 freedompi weewxd[17971]: INFO weewx.restx: WOW: Data for
station 00ef03c0-7cf6-ee11-a81c-0022489bcb24 will be posted
Apr 12 18:28:43 freedompi weewxd[17971]: INFO weewx.restx: AWEKAS: Posting
not enabled.
Apr 12 18:28:43 freedompi weewxd[17971]: INFO user.windy: version is 0.7
Apr 12 18:28:43 freedompi weewxd[17971]: INFO user.windy: Data will be
uploaded to https://stations.windy.com/pws/update
```

```
Apr 12 18:28:43 freedompi weewxd[17971]: INFO weewx.engine: 'pyephem'
detected, extended almanac data is available
Apr 12 18:28:43 freedompi weewxd[17971]: INFO __main__: Starting up weewx
version 5.0.2
Apr 12 18:28:43 freedompi weewxd[17971]: INFO weewx.engine: Using binding
'wx_binding' to database 'weewx.sdb'
Apr 12 18:28:43 freedompi weewxd[17971]: INFO weewx.manager: Starting
backfill of daily summaries
Apr 12 18:28:43 freedompi weewxd[17971]: INFO weewx.manager: Daily
summaries up to date
Apr 12 18:28:43 freedompi weewxd[17971]: INFO weewx.engine: Starting main
packet loop.
```

STEP 4, CREATE INIGO-SETTINGS.TXT

You need to change the inigo-settings.txt to provide details about your weather stations. Full details are available in the wiki

Once you're happy with your changes press ctrl+x to exit and save.

```
vrishabkakade@freedompi:/tmp $ sudo wget -O /var/www/html/weewx/inigo-settings.txt
https://github.com/evilbunny2008/weeWXWeatherApp/releases/download/1.0.3/inigo-settings.txt
vrishabkakade@freedompi:/tmp $ sudo vi /var/www/html/weewx/inigo-settings.txt
[weewx@cloud009 ~]$ cat /var/www/bettaforecast/inigo-settings.txt
```

```
data=https://bettaforecast.in/inigo-data.txt
radtype=image
radar=https://embed.windy.com/embed2.html?lat=-
34&lon=151&zoom=11&level=surface&overlay=radar&menu=&message=true&marker=&c
alendar=&pressure=true&type=map&location=coordinates&detail=&detailLat=-
34&detailLon=150&metricWind=km%2Fh&metricTemp=%C2%B0C&radarRange=-1
fctype=met.no
forecast=https://api.met.no/weatherapi/locationforecast/2.0/compact?altitud
e=1181&lat=12.359722&lon=77.879722
#webcam=http://mx.cafesydney.com:8888/mjpg/video.mjpg
#custom=http://m.bom.gov.au/nsw/sydney/radar/
```

STEP 5, USING OFFSET RAIN TIMES (OPTIONAL)

Historically rainfall is measured in Australia at 9am, so it's useful for comparison reasons to be able to display rain records matching time of day with the Bureau of Meteorology. To enable this simply edit /etc/weewx/since.tmpl and paste the following into it:

```
vrishabkakade@freedompi:/etc/weewx $ vi /etc/weewx/since.tmpl
```

```
#if $varExists('since')
$since($hour=9).rain.sum.formatted|$since($hour=9,$today=False).rain.sum.fo
rmatted|9am|#slurp
```

```
#else
|||#slurp
#end if
```

STEP 6, INSTALLING THE APP

You can now get the app from Google Play.

On first boot the app will prompt you for the URL to your inigo-settings.txt file, this is usually https://bettaforecast.in/inigo-settings.txt, once entered click save and in a few seconds you should be up and running.

Once saved the settings are cached by the app. If you need to tell the app to re-download the settings, you swipe from the left side of any screen to open the settings pane.

🧘 SETUP BELCHERTOWN SKIN

I really like this skin for all the customization options, documentation and real-time updates. In this section I will go through all the setup.

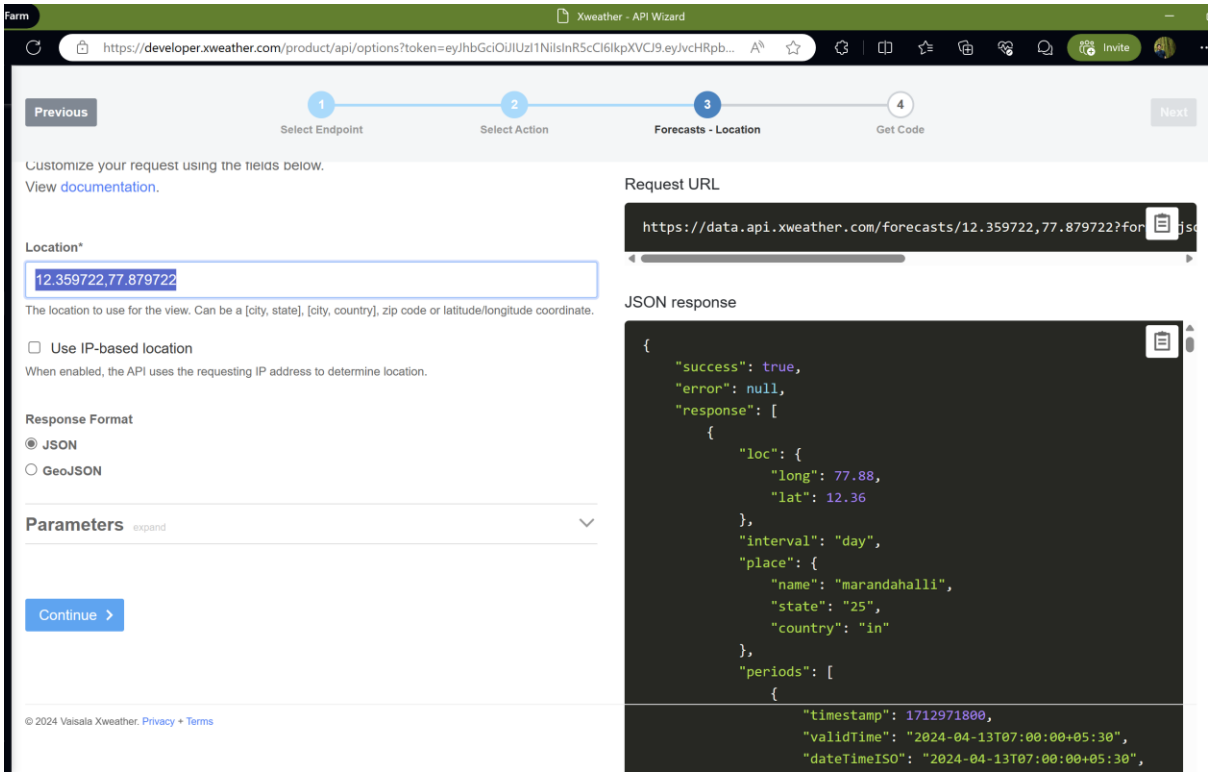
🌩️ AERISWEATHER FORECAST API (OPTIONAL)

Source: GitHub - poblabs/weewx-belchertown: A clean and modern weewx skin with real time streaming updates, forecast data and interactive charts. View it in action at BelchertownWeather.com

AerisWeather's Forecast API is where the current observations and forecast data comes from. The skin will work without this integration, however it is used to show current weather observations and icons as well as the forecast.

You must sign up to use their service. This skin does not provide any forecast data. You need to join their website and get a free developer key. In order to get a free developer key, you have to send your weather data to pwsweather.com - which is an integration built into weewx. You just need to activate it! Once enabled, by default the skin will download and cache every hour.

- If you haven't already; sign up for pwsweather at https://www.pwsweather.com/register
- Add a new station, and configure your weewx.conf to start sending your weather data to pwsweather.
- Then sign up for a free AerisWeather developer account by linking your pwsweather account here https://www.aerisweather.com/signup/pws
- Once you are logged in, you should make a Demo Project as part of the sign up process, then go to https://www.aerisweather.com/account/apps and and save these keys as forecast_api_id and forecast_api_secret.
- The rest of the options can be found below in the Forecast Options table.



Following the instructions on the website, I obtain my key.

INSTALL WEEWX-BELCHERTOWN SKIN

1. Download the latest release.

```
vrishabkakade@freedompi:/tmp $ wget https://github.com/poblabs/weewx-belchertown/releases/download/weewx-belchertown-1.3.1/weewx-belchertown-release.1.3.1.tar.gz
```

```
vrishabkakade@freedompi:~ $ sudo weectl extension install weewx-belchertown-release.1.3.1.tar
```

```
Using configuration file /etc/weewx/weewx.conf
Install extension 'weewx-belchertown-release.1.3.1.tar' (y/n)? y
Traceback (most recent call last):
File "/usr/share/weewx/weectl.py", line 74, in
main()
File "/usr/share/weewx/weectl.py", line 66, in main
namespace.func(namespace)
File "/usr/share/weewx/weectllib/init.py", line 121, in dispatch
namespace.action_func(config_dict, namespace)
File "/usr/share/weewx/weectllib/extension_cmd.py", line 116, in
install_extension
ext.install_extension(namespace.source, no_confirm=namespace.yes)
File "/usr/share/weewx/weecfg/extension.py", line 143, in install_extension
raise InstallError(f"Unrecognized type for {extension_path}")
```

```
weecfg.extension.InstallError: Unrecognized type for weewx-belchertown-release.1.3.1.tar
```

v1.3.1 Threw errors constantly. So I installed 1.3

```
wget https://github.com/poblabs/weewx-belchertown/releases/download/weewx-belchertown-1.3/weewx-belchertown-release-1.3.tar.gz

vrishabkakade@freedompi:/tmp $ sudo weectl extension install weewx-belchertown-release-1.3.tar.gz
```

```
Using configuration file /etc/weewx/weewx.conf
Install extension 'weewx-belchertown-release-1.3.tar.gz' (y/n)? y
Extracting from tar archive weewx-belchertown-release-1.3.tar.gz
Saving installer file to /etc/weewx/bin/user/installer/Belchertown
Saved copy of configuration as /etc/weewx/weewx.conf.20240413114922
Finished installing extension Belchertown from weewx-belchertown-release-1.3.tar.gz
```

Since I installed as sudo it changed it to root. Change permissions to weewx user

```
vrishabkakade@freedompi:/tmp $ cd /etc/weewx/
vrishabkakade@freedompi:/etc/weewx $ sudo chown weewx:weewx weewx.conf
vrishabkakade@freedompi:/etc/weewx $ cp weewx.conf weewx.conf.`date +%Y%m%d`
```

```
vrishabkakade@freedompi:~ $ sudo systemctl restart weewx
vrishabkakade@freedompi:~ $ sudo systemctl status weewx
```

I got the below error after the installation

```
Uncaught TypeError: Highcharts.chart is not a constructor
    at Object.<anonymous> (belchertown.js?1712999116:2407:25)
    at Function.each (jquery.min.js:2:2623)
    at Object.success (belchertown.js?1712999116:1462:16)
    at u (jquery.min.js:2:27457)
    at Object.fireWith [as resolveWith] (jquery.min.js:2:28202)
    at k (jquery.min.js:2:77651)
    at XMLHttpRequest.<anonymous> (jquery.min.js:2:79907)
```

After update to highcharts.js today we get Highcharts.chart is not a constructor - Stack Overflow

I changed the code like this:

```
vrishabkakade@freedompi:/etc/weewx/skins/Belchertown/js $ ls -lrat
```

```
total 304
-rw-rw-r--  1 weewx weewx    765 Apr 13 11:49 responsive-menu.js
-rw-rw-r--  1 weewx weewx     14 Apr 13 11:49 index.html
drwxr-sr-x 11 weewx weewx   4096 Apr 13 14:12 ..
```

```
-rw-r--r--  1 root  weewx 143973 Apr 13 14:51 belchertown.js.tmpl.orig
drwxr-sr-x  2 weewx weewx   4096 Apr 13 14:51 .
-rw-rw-r--  1 weewx weewx 143973 Apr 13 14:58 belchertown.js.tmpl
```

```
vrishabkakade@freedompi:/etc/weewx/skins/Belchertown/js $ vi belchertown.js.tmpl
```

Line 2895 comment and duplicate - remove new word as per the solution

```
            // Finally all options are done, now show the chart
            //var chart = new Highcharts.chart(options);
            var chart = Highcharts.chart(options);
```

SETUP SMB SERVER ON THE RASPBERRY PI

How to Setup a Raspberry Pi Samba Server - Pi My Life Up

I'm setting up a SMB server on Raspberry Pi to access the database file from my laptop which is Windows.

The first thing that we must do before we setup a SMB/CIFS share on our Raspberry Pi is to make sure everything is up to date.

We can update the package list and all our packages by running the following two commands.

```
sudo apt-get update
sudo apt-get upgrade
```

Now that we have our Raspbian operating system entirely up to date, we can now proceed on to installing the Samba software to our Raspberry Pi.

We can install the packages that we require to setup Samba by running the following command.

```
sudo apt-get install samba samba-common-bin
```

Now we can share this folder using the Samba software. To do this, we need to modify the samba config file.

The "smb.conf" configuration file is where you will store all your settings for your shares.

We can begin modifying the config file by running the command below.

```
sudo vi /etc/samba/smb.conf
```

```
[freedompishare]
path = /var/lib/weewx
writeable=Yes
create mask=0777
directory mask=0777
public=no
```

Next, we need to set up a user for our Samba share on the Raspberry Pi. Without it, we won't be able to make a connection to the shared network drive.

```
vrishabkakade@freedompi:/etc/weewx/skins/Belchertown $ sudo smbpasswd -a weewx
```

Finally, before we connect to our Raspberry Pi Samba share, we need to restart the samba service so that it loads in our configuration changes.

```
sudo systemctl restart smbd
```

MQTT AND MQTT WEBSOCKETS (OPTIONAL)

Source: How to setup your own MQTT Broker – O'Brien Labs (obrienlabs.net)

From the Author

I wrote this MQTT tutorial to help me out in the future, but hopefully it helps someone else along the way!

For the last few years I've been running a custom weather website. This website, in conjunction with weewx, allowed me to have a website which updated itself every 10 seconds. But this bothered me. **10 seconds was far too slow for my liking!**

Earlier this year (2018) I started using Home Assistant for home automation (goodbye old unreliable cloud-based automation!) and they opened me up to MQTT. It was great to be able to get data from tiny Arduino sensors around the house – but I knew I could do more with it. That's when I saw an MQTT extension available for weewx. I knew it was time for a website upgrade!

The result was a true real time auto updating website with no delay! Every time my weather station sends an update from the backyard (every 2.5 seconds), that data is immediately read by weewx which archives the data, runs some QC checks on it for accuracy, then publishes it to MQTT. Visitors on my website auto-subscribe to the MQTT topic through websockets and JavaScript updates the data on the webpage within milliseconds. It's really cool!

If you're not familiar with MQTT, it's a machine-to-machine internet of things (IoT) communication protocol. Initially designed as a lightweight publish/subscribe method useful for those devices in remote locations with limited internet connectivity. It even works great for Arduino or NodeMCU temperature sensors around the house. The device that needs to send data would publish to a topic, and the device that needs to receive that data would subscribe to that topic. Topic names are arbitrary, but they should make sense. For example a topic could be weather/weewx/loop. This could mean it's the weather parent category, the weewx software, and the loop function. Then you could have weather/weewx/archive for archive data, weather/rain_bucket/current if you had a rain bucket that can talk MQTT. Whatever you want!

I have weewx configured to publish weather loop data to the topic weather/weewx/loop, and my website is configured to subscribe on that topic.

Due to the high nature that weewx publishes weather data (currently my loop is at **2.5 seconds**), I couldn't use a free MQTT broker (or server), and I didn't want to pay for access to one. Some free ones will handle the frequent data, but offer no uptime reliability, so I decided to install my own broker.

- **Total time to setup: 5 – 30 minutes.**

This tutorial was created in 2018 using Ubuntu 18.04, so some things may be different after I write this or if you use another operating system.

You can run MQTT on a Raspberry Pi, but I recommend running MQTT on a cloud server because it's always available, fast and easy.

Running this on the virtual server

INSTALL MOSQUITTO

First install Mosquitto, which is the name of the MQTT software.

```
[weewx@cloud009 ~]$ sudo apt update
[weewx@cloud009 ~]$ sudo apt-get install mosquitto mosquitto-clients
```

Note: Do not use 'localhost'. Use the fully qualified domain name of the MQTT broker host or its IP address.

Source: MQTT for Belchertown skin (google.com)

SETUP WEBSOCKETS

If you plan on using your MQTT Broker for a website, like the Belchertown weewx skin, then you need to enable websockets.

Let's create a custom configuration file that we'll add this – and other items – to for Mosquitto's config. Run sudo nano /etc/mosquitto/conf.d/myconfig.conf and update it with the below:

```
[weewx@cloud009 ~]$ sudo vi /etc/mosquitto/conf.d/myconfig.con
```

```
persistence false

# mqtt
listener 1883
protocol mqtt

# websockets
listener 9001
protocol websockets
```

Make sure you have no empty spaces at the end of those lines or Mosquitto may give you an error.

Restart Mosquitto with sudo service mosquitto restart and you should now have a working MQTT server on port 1883 and websockets on port 9001!

```
[weewx@cloud009 ~]$ sudo service mosquitto restart
```

CREATE A USER AND ACCESS CONTROL

I locked down my broker so that only those clients who know the password can publish to a topic. You can get super granular here where certain usernames can publish to certain topics only. For my sake I only have 1 user who can publish. All other users who connect to the broker are considered anonymous and can only subscribe. Create a password for publishing with:

```
[weewx@cloud009 ~]$ sudo mosqusudo mosquitto_passwd -c /etc/mosquitto/passwd weewx
```

Next is to create an MQTT ACL (access control list) so that anonymous users are read only, but the weewx system can read and write to the weather topic. Run sudo nano /etc/mosquitto/acl and enter in:

```
[weewx@cloud009 ~]$ sudo vi /etc/mosquitto/acl
```

```
# Allow anonymous access to the sys
topic read $SYS/#

# Allow anonymous to read weather
topic read weather/#

# weewx readwrite to the loop
user weewx
topic weather/#
```

ADD TO THE CUSTOM BROKER CONFIGURATION

Now let's add the authentication and access control to the custom configuration file.
Run sudo nano /etc/mosquitto/conf.d/myconfig.conf and enter in:

```
[weewx@cloud009 ~]$ sudo vi /etc/mosquitto/conf.d/myconfig.conf
```

```
allow_anonymous true
password_file /etc/mosquitto/passwd

acl_file /etc/mosquitto/acl
```

Save your file and run mosquitto with `mosquitto -c /etc/mosquitto/mosquitto.conf` and with another SSH client, log into your server and check that the MQTT ports are open. Run this command `sudo netstat -tulpn | grep 1883` and you should see port 1883 open. Repeat with port 9001 to verify websockets are open. It should look something like:

```
tcp 0 0 127.0.0.1:1883 0.0.0.0:* LISTEN 973/mosquitto
```

If it's open like above then open 2 more SSH connections to your server to test publish and subscribe.

```
[weewx@cloud009 ~]$ sudo mosquitto -c /etc/mosquitto/mosquitto.conf
[weewx@cloud009 ~]$ sudo netstat -tulpn | grep 1883
```

```
tcp        0      0 127.0.0.1:1883          0.0.0.0:*               LISTEN
114850/mosquitto
tcp6       0      0 ::1:1883                ::::*                   LISTEN
114850/mosquitto
```

Session 1: run this command to subscribe to the weather topic.

`mosquitto_sub -h localhost -t weather/#`
The # means you want to listen on everything underneath weather. For example `weather/topic1`, `weather/topic2`, `weather/topic3`, etc.

Note: Only use # when troubleshooting. You shouldn't setup your website or application to publish or subscribe to # in a normal situation.

Session 2: try to publish using this command:

`mosquitto_pub -h localhost -t "weather/test" -m "hello world"`

```
[weewx@cloud009 ~]$ mosquitto_mosquitto_pub -h localhost -t "weather/test" -m "hello world"
[weewx@cloud009 ~]$ mosquitto_sub -h localhost -t weather/#
```

```
hello world
```

This command does not use any authentication so **it should fail**! Your mosquitto_sub window should not show anything. If you do not see anything, so far so good!

Now go back to SSH #2 (with the `mosquitto_pub`) and run this command which has authentication:
`mosquitto_pub -h localhost -t "weather/test" -m "hello world. this is to the weather topic with authentication" -u "<your username from above>" -P "<your password you created>"`

```
[weewx@cloud009 ~]$ mosquitto_mosquitto_pub -h localhost -t "weather/test" -m "hello world. this is to the weather topic with authentication" -u "weewx" -P "****"
[weewx@cloud009 ~]$ mosquitto_sub -h localhost -t weather/#
```

```
hello world
hello world. this is to the weather topic with authentication
```

You should see something in your `mosquitto_sub` window now! If you do, great! If not, back up and try everything again. Sometimes Mosquitto is fussy and requires a full reboot. You can also check the Mosquitto log file at `/var/log/mosquitto/mosquitto.log`

So if you've made it this far you have a working MQTT broker with authentication and websockets!

SETUP LETSENCRYPT SSL CERTIFICATE (OPTIONAL)

Using the SSL cert setup with the website

ADD YOUR SSL CERT TO MQTT CONFIG

Update your custom MQTT config file and add the new SSL certificates. Run `sudo nano /etc/mosquitto/conf.d/myconfig.conf` and update it with the below:

```
[weewx@cloud009 ~]$ sudo vi /etc/mosquitto/conf.d/myconfig.conf
```

```
allow_anonymous true
password_file /etc/mosquitto/passwd


acl_file /etc/mosquitto/acl

persistence false

# mqtt
listener 1883
listener 8883
certfile /etc/mosquitto/certs/cert.pem
cafile /etc/mosquitto/certs/chain.pem
keyfile /etc/mosquitto/certs/privkey.pem
protocol mqtt

# websockets
listener 9001
certfile /etc/mosquitto/certs/cert.pem
cafile /etc/mosquitto/certs/chain.pem
keyfile /etc/mosquitto/certs/privkey.pem
```

```
[weewx@cloud009 ~]$ sudo ls -lrat /etc/letsencrypt/archive/bettaforecast.in
```

```
total 24
-rw------- 1 root root 1704 Apr 12 16:35 privkey1.pem
-rw-r--r-- 1 root root 3595 Apr 12 16:35 fullchain1.pem
-rw-r--r-- 1 root root 1826 Apr 12 16:35 chain1.pem
-rw-r--r-- 1 root root 1769 Apr 12 16:35 cert1.pem
drwx------ 3 root root 4096 Apr 12 16:35 ..
drwxr-xr-x 2 root root 4096 Apr 12 16:35 .
```

I get the below error with the above permissions

```
1713070124: Error: Unable to load CA certificates. Check cafile
"/etc/letsencrypt/live/bettaforecast.in/chain.pem".
1713070124: OpenSSL Error[0]: error:8000000D:system library::Permission
denied
1713070124: OpenSSL Error[1]: error:10080002:BIO routines::system lib
1713070124: OpenSSL Error[2]: error:05880002:x509 certificate
routines::system lib
```

Copy the certificates to a new location and change permissions there so that we don't affect the Apache Letsencrypt certificates.

```
[root@cloud009 ~]$ cat /etc/mosqu/etc/mosquitto/certs/copy_ssl_certs_mqtt.sh
```

```
#!/bin/bash
SHELL=/bin/bash
export
PATH=/usr/local/sbin:/usr/local/bin:/usr/sbin:/usr/bin:/sbin:/bin:/usr/game
s:/usr/local/games:/snap/bin:$PATH
cp /etc/letsencrypt/live/bettaforecast.in/privkey.pem /etc/mosquitto/certs
cp /etc/letsencrypt/live/bettaforecast.in/fullchain.pem
/etc/mosquitto/certs
cp /etc/letsencrypt/live/bettaforecast.in/chain.pem /etc/mosquitto/certs
cp /etc/letsencrypt/live/bettaforecast.in/cert.pem /etc/mosquitto/certs
```

Put it in the crontab so the script can run everyday.

```
[root@cloud009 ~]$ crontab -l
```

```
52 *    *    *    *    cd /etc/mosquitto/certs && /usr/bin/sh
/etc/mosquitto/certs/copy_ssl_certs_mqtt.sh >>
/etc/mosquitto/certs/copy_ssl_certs_mqtt.log 2>&1
0    0 * * 0 /home/weewx/backup_scripts/backup_weewx.sh
```

Restart your mosquitto server with `sudo service mosquitto restart` and check that the ports are open with `sudo netstat -tulpn | grep -E '8883|9001'`. You should see something similar to:

```
[weewx@cloud009 /etc/mosquitto/certs]$ sudo service mosquitto restart

[weewx@cloud009 /etc/mosquitto/certs]$ sudo netstat -tulpn | grep -E '8883|9001'
```

```
tcp        0      0 0.0.0.0:8883            0.0.0.0:*               LISTEN
123262/mosquitto
tcp6       0      0 :::9001                 :::*                    LISTEN
123262/mosquitto
tcp6       0      0 :::8883                 :::*                    LISTEN
123262/mosquito
```

INSTALL MOSQUITO ON THE RASPBERRY PI

We need Mosquito installed on the Raspberry Pi as well since the messages get sent in real-time from the Raspberry Pi to the web server.

```
weewx@freedompi:~$ sudo apt update
weewx@freedompi:~$ sudo apt-get install mosquitto mosquitto-clients
weewx@freedompi:~$ sudo service mosquitto start
```

Test it

```
mosquitto_pub -h bettaforecast.in -t "weather/test" -m "hello world. this
is to the weather topic with authentication 2" -u "weewx" -P "***"
```

CUSTOMIZE THE GRAPHS

Source: Belchertown Charts Documentation · poblabs/weewx-belchertown Wiki (github.com)

The document is very well written and I have made a lot of customizations. Refer to the below file

```
weewx@freedompi:/etc/weewx/skins/Belchertown$ ls -lrat graphs.conf
```

```
-rw-r--r-- 1 weewx weewx 23308 Apr 17 09:40 graphs.conf
```

SCRIPT TO AUTOMATE COPYING OF CERTS FOR MQTT

Below is a script to automate copying over the SSL certs to MQTT

Source certs

```
[weewx@cloud009 ~]$ sudo ls -lrat /etc/letsencrypt/live/bettaforecast.in
```

```
total 12
lrwxrwxrwx 1 root root   43 Apr 12 16:35 privkey.pem ->
../../archive/bettaforecast.in/privkey1.pem
lrwxrwxrwx 1 root root   45 Apr 12 16:35 fullchain.pem ->
../../archive/bettaforecast.in/fullchain1.pem
lrwxrwxrwx 1 root root   41 Apr 12 16:35 chain.pem ->
../../archive/bettaforecast.in/chain1.pem
lrwxrwxrwx 1 root root   40 Apr 12 16:35 cert.pem ->
../../archive/bettaforecast.in/cert1.pem
drwx------ 3 root root 4096 Apr 12 16:35 ..
drwxr-xr-x 2 root root 4096 Apr 12 16:35 .
-rw-r--r-- 1 root root  692 Apr 12 16:35 README
```

MQTT Certs

```
[weewx@cloud009 ~]$ ls -lrat /etc/mosquitto/certs
```

```
total 28
-rw-r--r-- 1 weewx weewx  130 Nov 19 23:39 README
drwxr-xr-x 5 root  root  4096 Apr 14 08:43 ..
-rwxr-xr-x 1 weewx weewx 1704 Apr 14 10:24 privkey.pem
-rwxr-xr-- 1 weewx weewx 3595 Apr 14 10:24 fullchain.pem
-rwxr-xr-- 1 weewx weewx 1826 Apr 14 10:24 chain.pem
-rwxr-xr-- 1 weewx weewx 1769 Apr 14 10:24 cert.pem
drwxr-xr-x 2 weewx weewx 4096 Apr 14 22:38 .
```

```
[weewx@cloud009 ~]$ cd /etc/mosquitto/certs
[weewx@cloud009 /etc/mosquitto/certs]$ vi copy_ssl_certs_mqtt.sh
```

```
#!/bin/bash
SHELL=/bin/bash
export
PATH=/usr/local/sbin:/usr/local/bin:/usr/sbin:/usr/bin:/sbin:/bin:/usr/game
s:/usr/local/games:/snap/bin:$PATH
cp /etc/letsencrypt/live/bettaforecast.in/privkey.pem /etc/mosquitto/certs
cp /etc/letsencrypt/live/bettaforecast.in/fullchain.pem
/etc/mosquitto/certs
cp /etc/letsencrypt/live/bettaforecast.in/chain.pem /etc/mosquitto/certs
cp /etc/letsencrypt/live/bettaforecast.in/cert.pem /etc/mosquitto/certs
```

```
[weewx@cloud009 /etc/mosquitto/certs]$ chmod 755 copy_ssl_certs_mqtt.sh
```

```
[root@cloud009 ~]$ crontab -e
```

```
# m h  dom mon dow   command
52 *    *    *    *    cd /etc/mosquitto/certs && /usr/bin/sh
/etc/mosquitto/certs/copy_ssl_certs_mqtt.sh >>
/etc/mosquitto/certs/copy_ssl_certs_mqtt.log 2>&1
```

In my case I had to restart cron. No jobs were running from any user.

```
[root@cloud009 /etc/mosquitto/certs]$ sudo systemctl restart cron
```

Copy the certs to the raspberry pi as well

```
weewx@bettaforecastpi:/tmp/certs $ ls -lrat /etc/mosquitto/certs
```

```
total 28
drwxr-xr-x 5 root  root  4096 May  9 20:05 ..
-rwxr-xr-x 1 weewx weewx 1826 May  9 20:16 chain.pem
-rwxr-xr-x 1 weewx weewx 1704 May  9 20:16 privkey.pem
-rwxr-xr-x 1 weewx weewx  130 May  9 20:16 README
-rwxr-xr-x 1 weewx weewx 3595 May  9 20:16 fullchain.pem
-rwxr-xr-x 1 weewx weewx 1769 May  9 20:16 cert.pem
drwxr-xr-x 2 root  root  4096 May  9 20:17 .
```

🛠 INSTALL MQTT EXTENSION FOR WEEWX

Source: [mqtt · weewx/weewx Wiki (github.com)]

```
weewx@freedompi:~$ sudo pip3 install paho-mqtt==1.6.1
weewx@freedompi:~$ wget -O weewx-mqtt.zip https://github.com/matthewwall/weewx-
mqtt/archive/master.zip

weewx@freedompi:~$ sudo weectl extension install weewx-mqtt.zip
```

WINDY (OPTIONAL)

Source: [matthewwall/weewx-windy: uploader for windy.com (github.com)]

Install this extension if you want to upload your data to Windy.com

```
weewx@bettaforecastpi:/var/lib/weewx $ cd /tmp
weewx@bettaforecastpi:/tmp $ wget -O weewx-windy.zip https://github.com/matthewwall/weewx-
windy/archive/master.zip
weewx@bettaforecastpi:/tmp $ sudo weectl extension install  weewx-windy.zip
```

SITEMAP (OPTIONAL)

Sources:

https://www.youtube.com/watch?v=HDJAyf007sI

clusterednetworks/sitemap-generator-cron: A script to be run as a cronjob using sitemap-generator-cli (github.com)

lgraubner/sitemap-generator-cli: Creates an XML-Sitemap by crawling a given site. (github.com)

If you want search engines to pick up your site, you will need to generate a sitemap.xml file.

I ended up using this script. Follow the instructions as per the Github page.

poblabs/sitemap-generator (github.com)

BACKUP

Source: Backup & restore - WeeWX 5.0

To back up a WeeWX installation, you will need to make a copy of

- the configuration information (**weewx.conf**),
- skins and templates,
- custom code, and
- the WeeWX database.

The location of these items depends on how you installed WeeWX.

Debian

Item	Location
Configuration	**/etc/weewx/weewx.conf**
Skins	**/etc/weewx/skins**
Custom code	**/etc/weewx/bin/user**
Database	**/var/lib/weewx/weewx.sdb**

It is not necessary to back up the generated images, HTML files, or NOAA reports, because WeeWX can easily regenerate them.

It is also not necessary to back up the WeeWX code, because it can be installed again. However, it doesn't hurt to do so.

Note

For a SQLite configuration, do not make the copy of the database file while in the middle of a transaction! Schedule the backup for immediately after an archive record is written, and then make sure the backup completes before the next archive record arrives. Alternatively, stop WeeWX, perform the backup, then start WeeWX.

Note

For a MySQL/MariaDB configuration, save a dump of the archive database.

Below is my script for backups

On the Pi:

```
vrishabkakade@freedompi:~/backup_scripts $ cat backup_weewx.sh
```

```
cd /mnt/backup
sudo touch weewx_bkp_`hostname`_`date +%Y%m%d`.log
sudo chmod 777 weewx_bkp_`hostname`_`date +%Y%m%d`.log
sudo tar -zcvf weewx_bkp_`hostname`_`date +%Y%m%d`.tar /var/lib/weewx
/var/www/html/weewx /etc/weewx /etc/apache2 /etc/mosquitto
/home/vrishabkakade >> weewx_bkp_`hostname`_`date +%Y%m%d`.log

if [ `sudo echo $?` -eq 0 ]
then
  sudo echo "Backup Success" >> weewx_bkp_`hostname`_`date +%Y%m%d`.log
else
  sudo echo "Backup failed" >> weewx_bkp_`hostname`_`date +%Y%m%d`.log
fi
```

I run it once a week

```
vrishabkakade@freedompi:~ $ crontab -l
```

```
0    0 * * 0 /home/vrishabkakade/backup_scripts/backup_weewx.sh
```

ON WEB SERVER

```
[weewx@cloud009 ~]$ cd backup_scripts/
[weewx@cloud009 ~/backup_scripts]$ vi backup_weewx.sh
[weewx@cloud009 ~/backup_scripts]$
[weewx@cloud009 ~/backup_scripts]$
[weewx@cloud009 ~/backup_scripts]$ chmod +x backup_weewx.sh
[weewx@cloud009 ~/backup_scripts]$ cat backup_weewx.sh
```

```
cd /mnt/backup
sudo touch weewx_bkp_`hostname`_`date +%Y%m%d`.log
sudo chmod 777 weewx_bkp_`hostname`_`date +%Y%m%d`.log
sudo tar -zcvf weewx_bkp_`hostname`_`date +%Y%m%d`.tar /var/www
/etc/apache2 /home/weewx /etc/letsencrypt >> weewx_bkp_`hostname`_`date
+%Y%m%d`.log

if [ `sudo echo $?` -eq 0 ]
then
  sudo echo "Backup Success" >> weewx_bkp_`hostname`_`date +%Y%m%d`.log
else
  sudo echo "Backup failed" >> weewx_bkp_`hostname`_`date +%Y%m%d`.log
fi
```

I have to run it as root as it keeps prompting for sudo password otherwise

```
[root@cloud009 ~]$ crontab -l
```

```
52 *   *   *   *    cd /etc/mosquitto/certs && /usr/bin/sh
/etc/mosquitto/certs/copy_ssl_certs_mqtt.sh >>
/etc/mosquitto/certs/copy_ssl_certs_mqtt.log 2>&1
0   0 * * 0 /home/weewx/backup_scripts/backup_weewx.sh
```

! ISSUES AND FIXES

MQTT WON'T WORK ON FIREFOX

https://support.mozilla.org/en-US/questions/1324001

```
Error:
the connection to wss:bettaforecast.in:9001 mqtt was interrupted while the
page was loading.
```

Your page's behavior seems to match a pattern of problems with Firefox attempting to make an SSL connection to MQTT servers via HTTP/2. Users can disable HTTP/2 for Websockets --

(1) In a new tab, type or paste **about:config** in the address bar and press Enter/Return. Click the button accepting the risk.

(2) In the search box in the page, type or paste **websockets** and pause while the list is filtered

(3) Double-click the **network.http.spdy.websockets** preference to switch the value from true to false (switches Firefox from using HTTP/2 to HTTP/1.1 for WebSockets)

-- but that isn't something the server could dictate to Firefox users.

- https://github.com/eclipse/paho.mqtt.javascript/issues/231
- https://github.com/eclipse/mosquitto/issues/1211

What makes this even stranger is that the Websocket connection the page is making to the radar server is working just fine with the standard setting. ??

Read this answer in context 👍 1