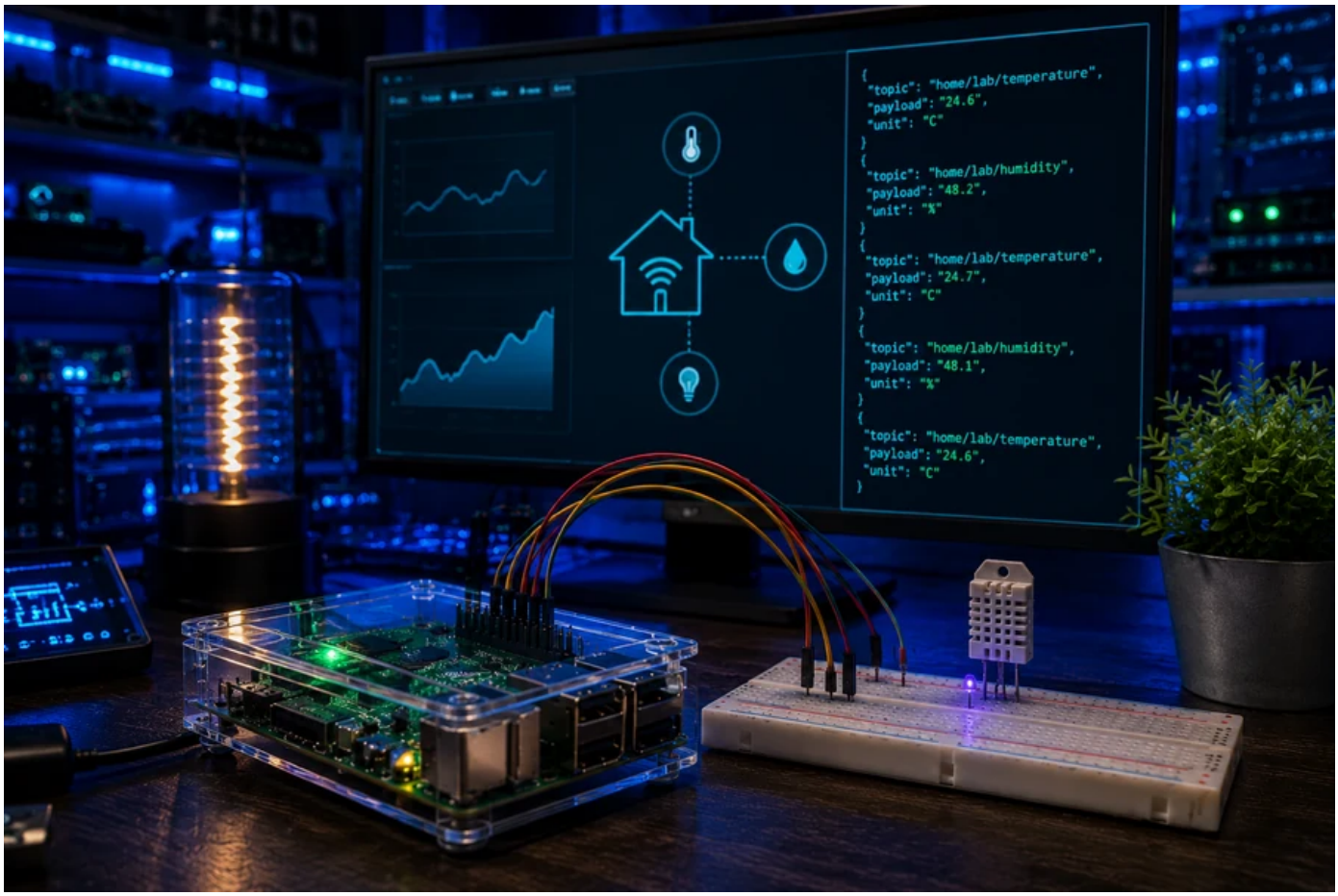
WolfieWeb Raspberry Pi MQTT Sensor Hub Lab Manual

Super detailed wiring and install instructions for building a DHT22 MQTT sensor node on Raspberry Pi.



What You Will Build

This project turns a Raspberry Pi into a local MQTT sensor hub. The Pi reads temperature and humidity from a DHT22 sensor, publishes the reading to a Mosquitto MQTT broker, and lets other devices subscribe to that live data. This is the foundation for dashboards, smart-home automation, alert systems, and sensor history logging.

Important Safety Rule

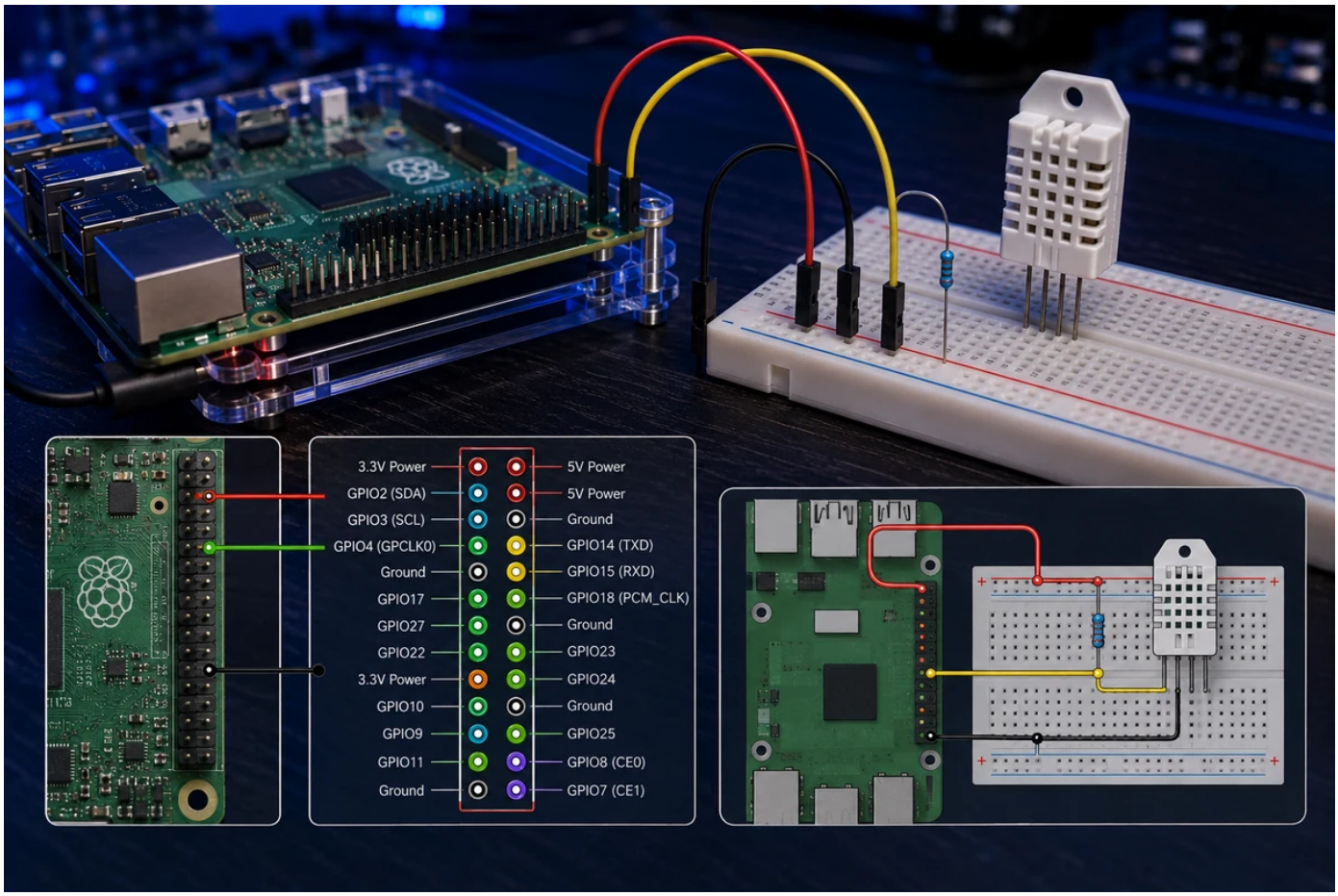
Raspberry Pi GPIO pins are 3.3V logic pins. Do not connect 5V directly to any GPIO data pin. For this DHT22 build, power the sensor from 3.3V and keep the DATA line pulled up to 3.3V through a 10K resistor.

Parts Needed

Part	Purpose	Notes
Raspberry Pi 4 or Raspberry Pi 5	Runs Mosquitto broker and Python publisher	Use a reliable 5V USB-C power supply.
DHT22 temperature/humidity sensor	Measures temperature and humidity	A module version may already include a pull-up resistor.

Breadboard	Temporary wiring platform	Use clean rows and avoid loose wires.
Jumper wires	GPIO to breadboard connections	Female-to-male wires are usually easiest.
10K resistor	Pull-up resistor between VCC and DATA	Needed for bare DHT22 sensors.
MicroSD card	Raspberry Pi OS storage	Use a quality card to avoid corruption.

Detailed GPIO Wiring



Wiring Table

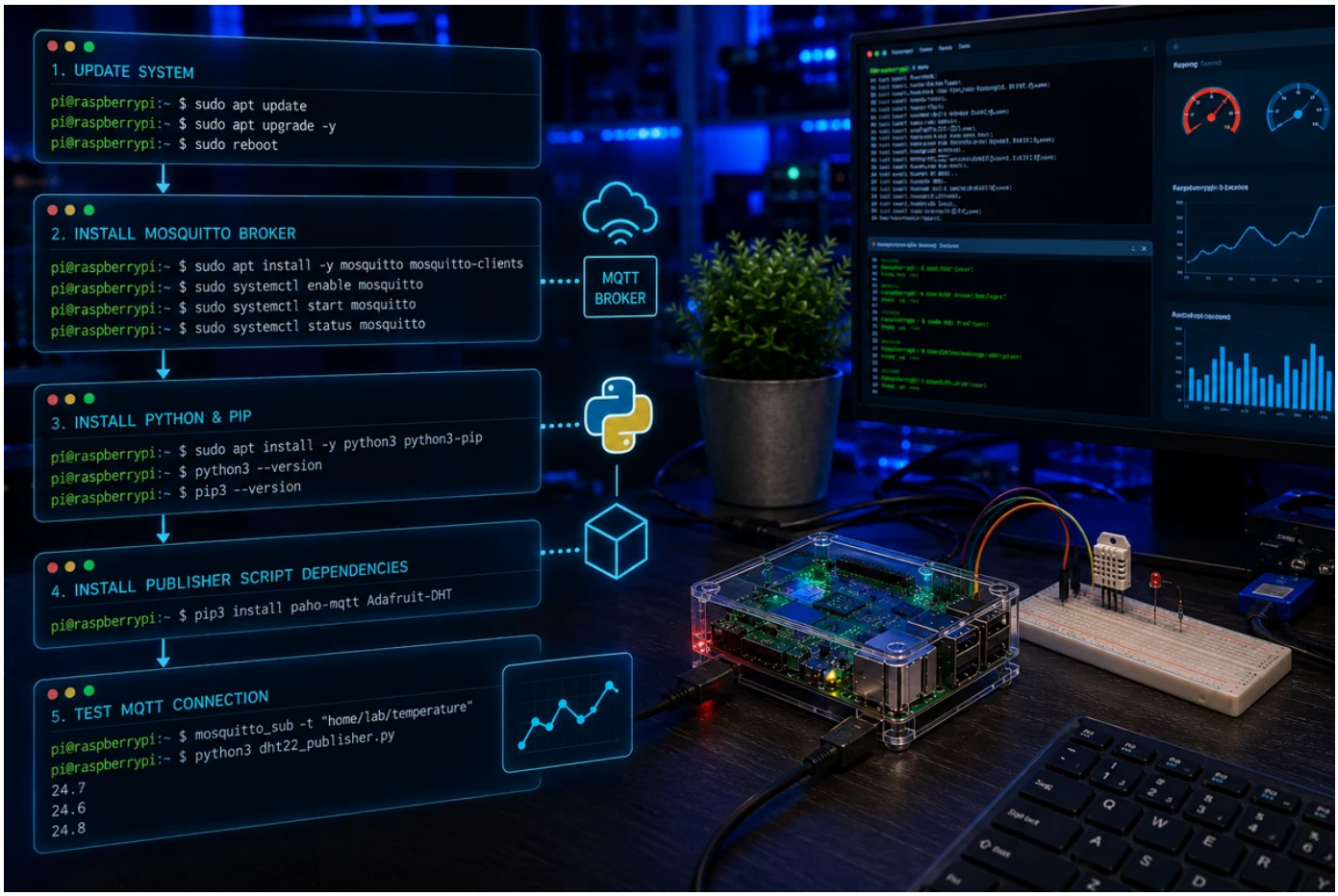
DHT22 Pin	Connects To	Why It Matters
VCC	Raspberry Pi 3.3V	Powers the sensor safely for Pi GPIO logic.
DATA	GPIO4 / physical pin 7	Carries temperature and humidity readings.
GND	Any Raspberry Pi ground pin	Completes the circuit and gives a shared reference.
10K resistor	Between VCC and DATA	Keeps DATA high when the sensor is not pulling it low.

Physical pin reminders: 3.3V is available on physical pin 1 or 17. GPIO4 is physical pin 7. Ground is available on many pins, including physical pin 6. If your DHT22 module already has three pins labeled +, OUT, and -, use + for 3.3V, OUT for GPIO4, and - for ground.

SVG Pin Placement Diagram

The ZIP includes an editable SVG diagram at images/mqtt_sensor_hub_gpio_pin_placement.svg. Use that SVG on the web page, inside printable guides, or as the base for future diagrams.

Install Mosquitto MQTT Broker



Run these commands in Terminal on the Raspberry Pi:

```
sudo apt update
sudo apt install mosquitto mosquitto-clients -y
sudo systemctl enable --now mosquitto
sudo systemctl status mosquitto
```

You want the service status to show active/running. If it is not running, restart it with sudo systemctl restart mosquitto and check the status again.

Install Python Libraries

```
sudo apt install python3-pip libgpiod2 -y
pip3 install paho-mqtt adafruit-circuitpython-dht
```

If Raspberry Pi OS blocks system-wide pip installs, create a virtual environment: python3 -m venv mqtt-env, source mqtt-env/bin/activate, then run the pip install command inside the environment.

Subscriber Test

Open a second Terminal window and subscribe to the topic before running the publisher script:

```
mosquitto_sub -h localhost -t home/pi/lab
```

Python Publisher Script

```
import time
import board
import adafruit_dht
import paho.mqtt.client as mqtt

sensor = adafruit_dht.DHT22(board.D4)

client = mqtt.Client(mqtt.CallbackAPIVersion.VERSION2)
client.connect("localhost", 1883, 60)

while True:
    try:
        temperature = sensor.temperature
        humidity = sensor.humidity
        payload = f"temperature={temperature},humidity={humidity}"
        client.publish("home/pi/lab", payload)
        print("Published:", payload)

    except RuntimeError as error:
        print("Sensor read failed:", error.args[0])

    time.sleep(5)
```

Save this as mqtt_sensor_publisher.py. Run it with python3 mqtt_sensor_publisher.py. If the subscriber terminal shows new messages every few seconds, your MQTT chain is working.

Troubleshooting Checklist

Problem	Likely Cause	Fix
No readings appear	Wrong topic or script not running	Use the exact same topic in publish and subscribe.
Sensor read failed	Loose wire or missing pull-up resistor	Check VCC, DATA, GND, and 10K resistor placement.
Broker connection refused	Mosquitto not running	Run sudo systemctl status mosquitto.
Remote device cannot subscribe	Wrong broker IP or firewall/network issue	Use hostname -I and test from same Wi-Fi network.
Readings are unstable	Power noise or weak jumper connection	Shorten wires and reseat breadboard connections.

Upgrade Path

Once the basic sensor hub works, upgrade it into a full IoT system. Start with JSON payloads, then add a Flask dashboard, SQLite logging, Node-RED flows, Home Assistant integration, or alert notifications.

Example JSON Payload

```
import json
payload = json.dumps({"temperature": temperature, "humidity": humidity})
client.publish("home/pi/lab", payload)
```

Final Build Test

A finished build should pass these checks: Mosquitto service is active, DHT22 wiring is stable, subscriber terminal receives messages, messages refresh every few seconds, and no GPIO pin is connected to 5V data. If all five checks pass, the sensor hub is ready for dashboard and automation upgrades.