IoT Weather Station with Mobile Dashboard

A multi-sensor ESP32 weather node (DHT22, BMP280, rain gauge, anemometer) publishing to a live MQTT dashboard with graphs and alerts.

1. Introduction / Background

A weather station is the classic end-to-end IoT build: sensing, calibration, wireless telemetry, storage, visualization and alerting in one system.

This station measures temperature, humidity, pressure, rainfall and wind speed with real sensors, publishes over Wi-Fi via MQTT, and presents the data on a live web dashboard.

2. Problem Statement

Students often build ‘weather stations’ that show raw sensor numbers with no units, no calibration discipline and no usable history. This project treats meteorological sensing seriously: physical units, datasheet accuracies, derived quantities like heat index, and a calibration procedure against a reference.

3. Objectives

- Measure temperature, humidity, pressure, rainfall and wind speed with calibrated real sensors.
- Publish readings via MQTT to a live dashboard with 24-hour graphs and daily totals.
- Fire push alerts on heat, rain-rate and wind-gust thresholds.

4. Proposed Methodology

The ESP32 samples DHT22 (temperature/humidity), BMP280 (pressure), a tipping-bucket rain gauge (0.3 mm/tip) and a reed-switch anemometer on a fixed schedule, converts counts to physical units with debouncing, packs JSON payloads and publishes via MQTT. The backend stores the series; the dashboard renders live values, graphs, daily rainfall and computed heat index.

5. System Architecture / Working

- Node: ESP32 + DHT22 + BMP280 + tipping bucket + anemometer; deep-sleep option for solar power.
- Telemetry: JSON over MQTT at a configurable interval (design target 60 s) with reconnect handling.
- Cloud: time-series storage, dashboard (live values, 24 h graphs, heat index), threshold alert service with push notifications.

6. Hardware / Software Requirements

- ESP32 dev board, DHT22, BMP280, tipping-bucket rain gauge, cup anemometer, MQTT broker, cloud dashboard, push-alert service.

- Arduino IDE (C/C++); USB 5 V or solar + Li-ion power option.

7. Expected Outcomes

- A working 4-channel weather node streaming to a live dashboard.
- Buyer-run calibration check against a reference thermometer.
- A complete report, PPT and viva Q&A; on sensor principles, MQTT and heat-index derivation.

8. Applications

- Campus weather display.
- Agriculture/farm micro-climate logging.
- Teaching IoT telemetry and sensor calibration.

9. Future Scope

- Wind-direction vane.
- LoRa uplink for off-grid fields.
- Local weather forecasting from pressure trends.

10. Conclusion

The station demonstrates the full IoT loop with honest metrology: datasheet accuracies stated, calibration performed by the buyer, and derived quantities computed properly.