OpenIoTwx

Improving the Accessibility of Open Source Weather Sensing & Data

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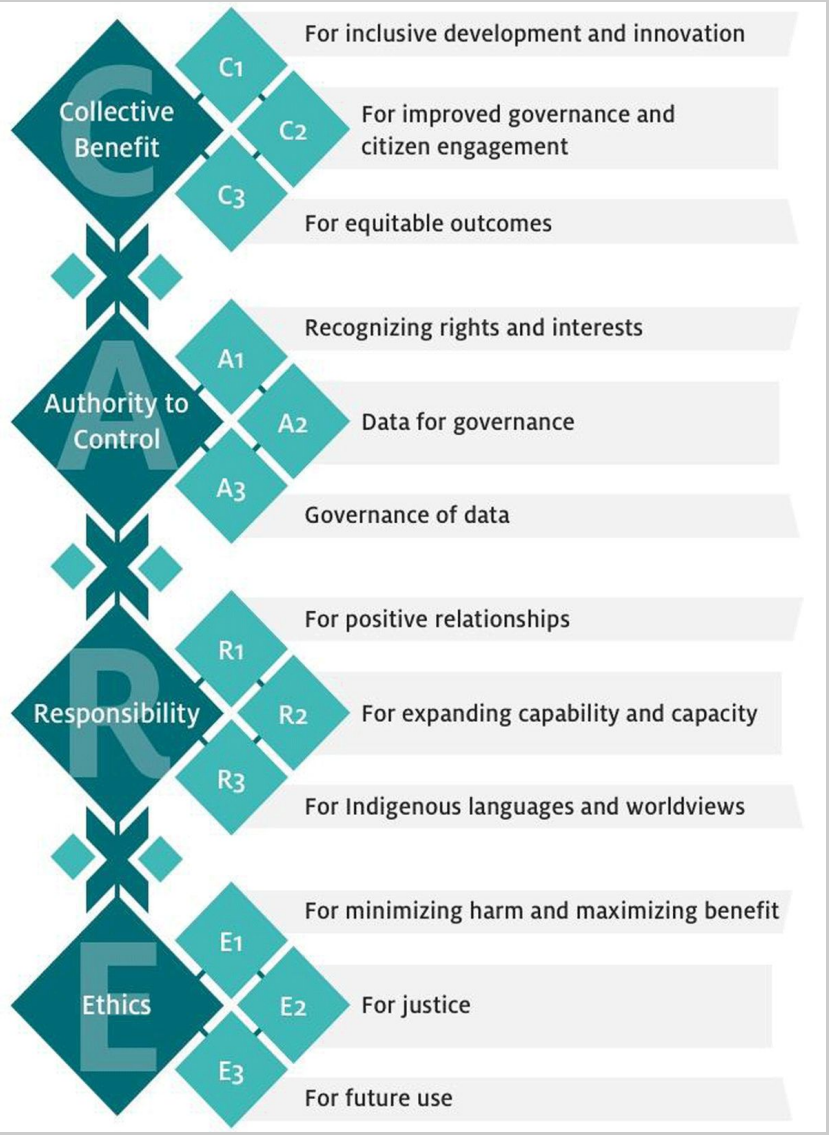
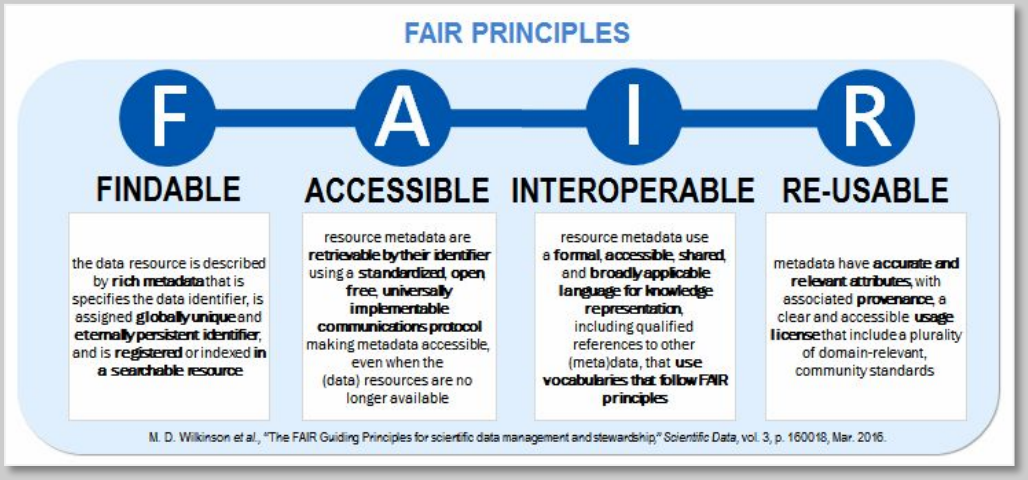
What is OpenIoTwx

- Personal Weather Station grade, modular, sensor set
- End-to-end Open Source
- 3d printable body
- Easy to assemble electronics
- Created for educational trainings and data equity work.

Our Philosophy

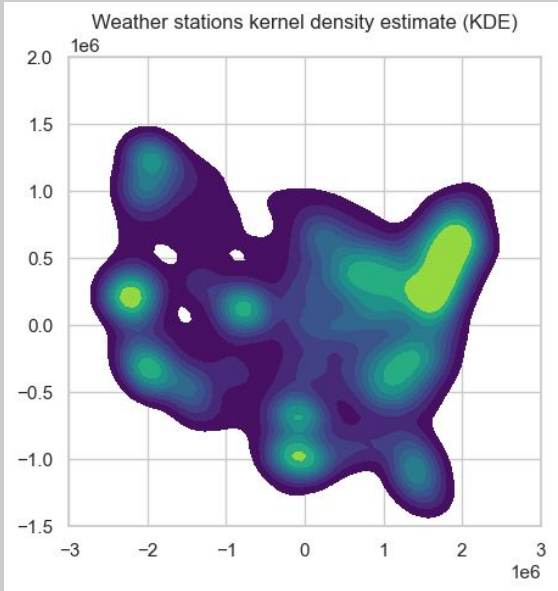


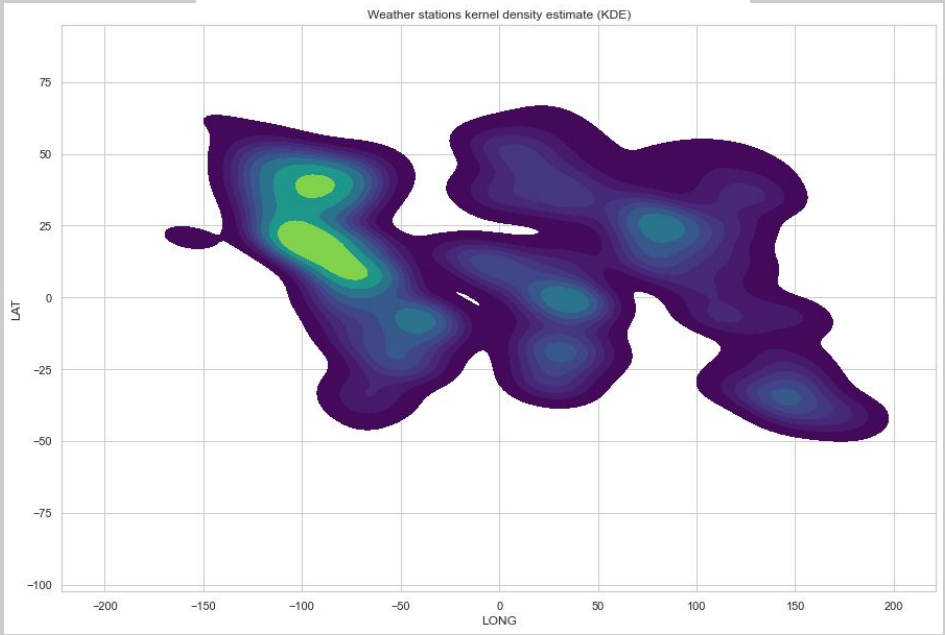
We follow FAIR and CARE principles for data maintenance and governance



Data Equity

- Inequity both globally and nationally
- Missing personal data on the global scale, skewing measurements
- Data deserts, especially in rural, impoverished, and indigenous communities



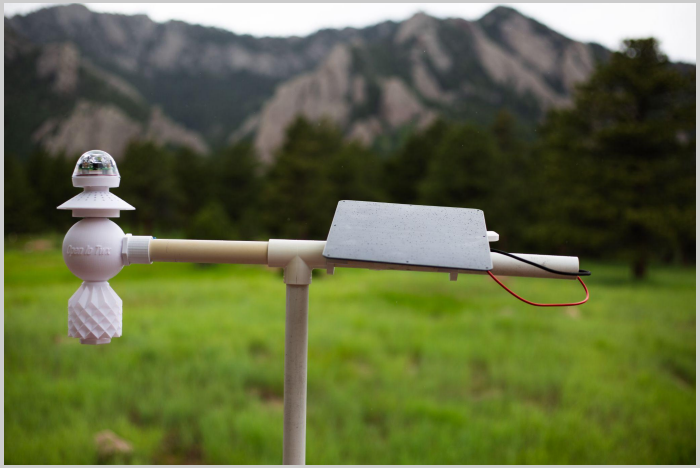


Why OpenIoTwx

The NCAR/UCAR 3D-printable progression

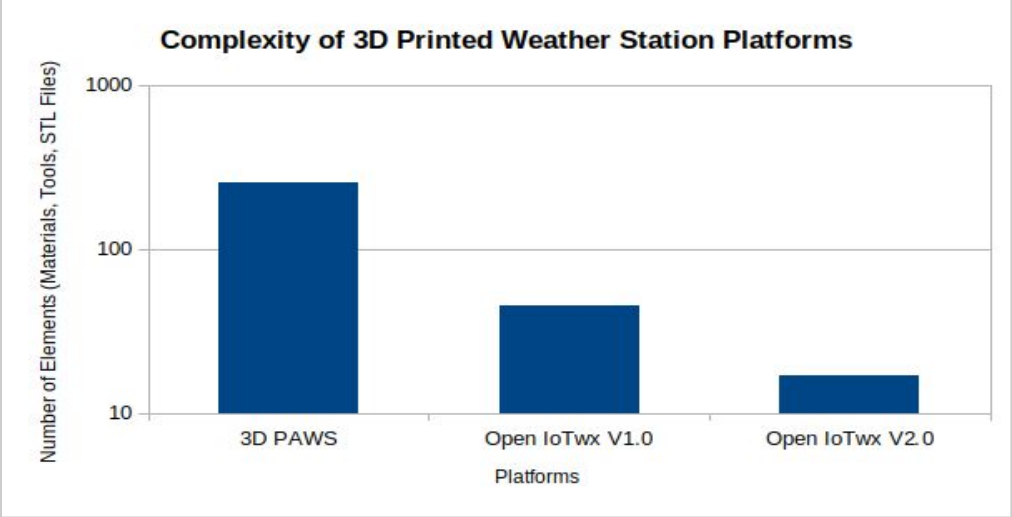
3DPaws (UCAR COMET)

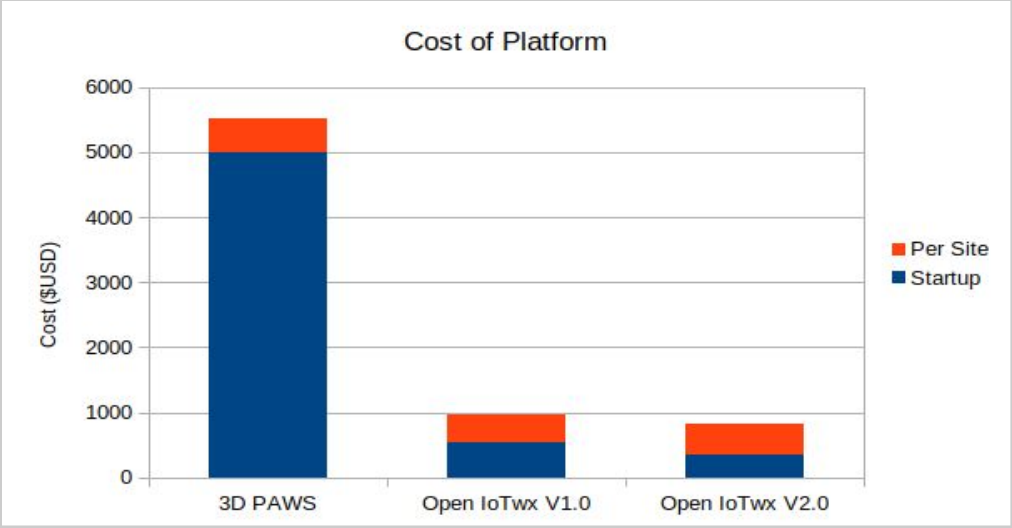
OpenIoTwx V1



OpenIoTwx V2

Why OpenIoTwx





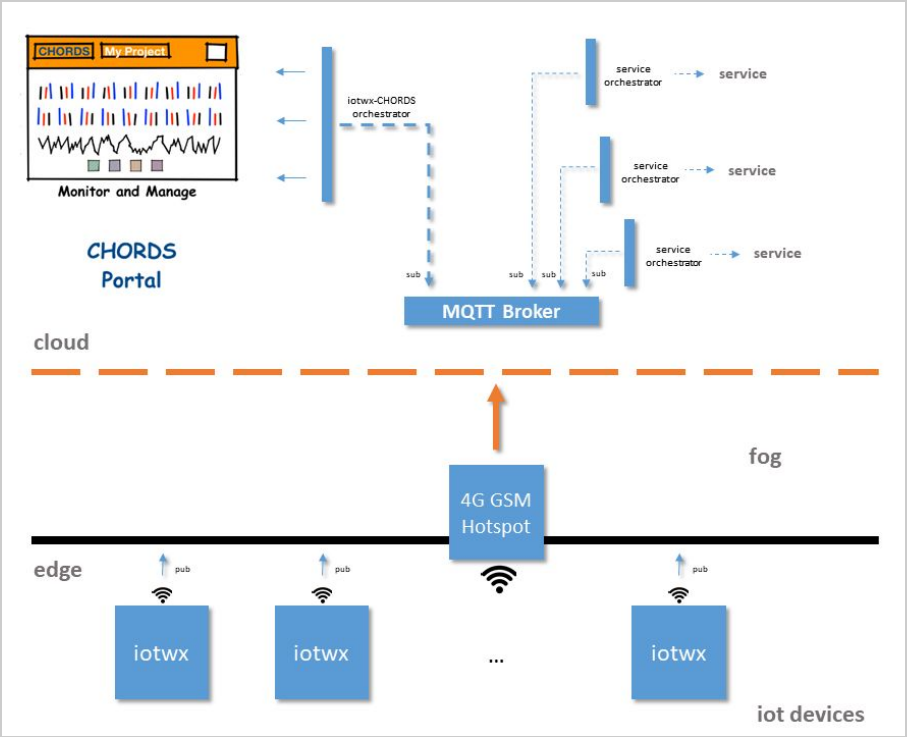
Internet Of Things and Edge Computing

Edge Computing:

- Decentralized computing paradigm
- Processing closer to data source
- Enables real-time analysis, faster response, and lowers bandwidth requirements.

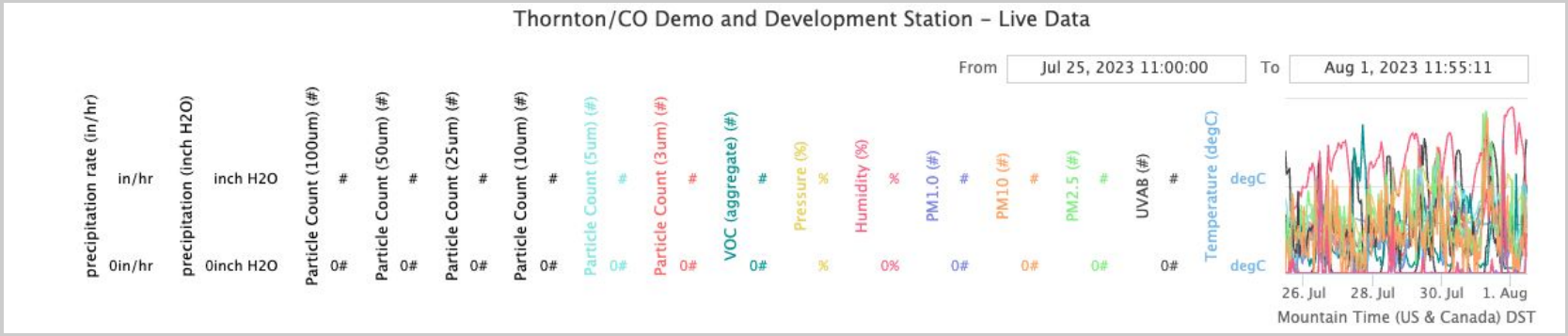
Internet of Things (IoT):

- Network of connected physical objects
- Embedded with sensors and software
- Collects and exchanges data over the internet.



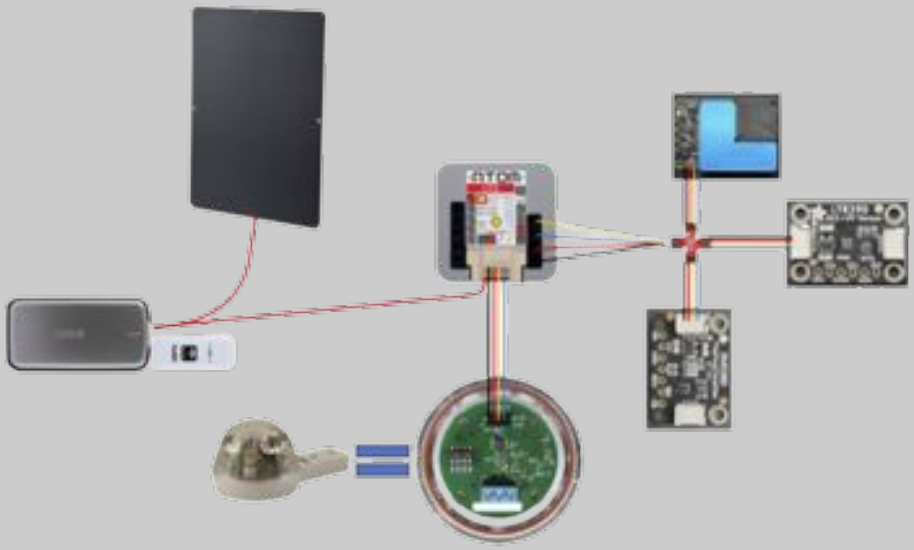
Sensors

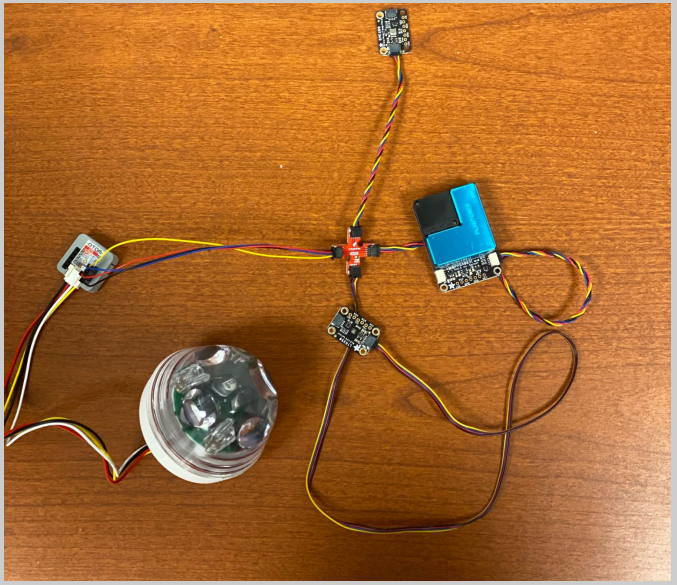
- BME680 - Temperature, Humidity, Pressure, VOC
- RG15 - Precipitation quantity and rate
- LTR390 - UV
- PMSA003I - Air Quality and Particulate
- SCD40 - CO2



Electronics

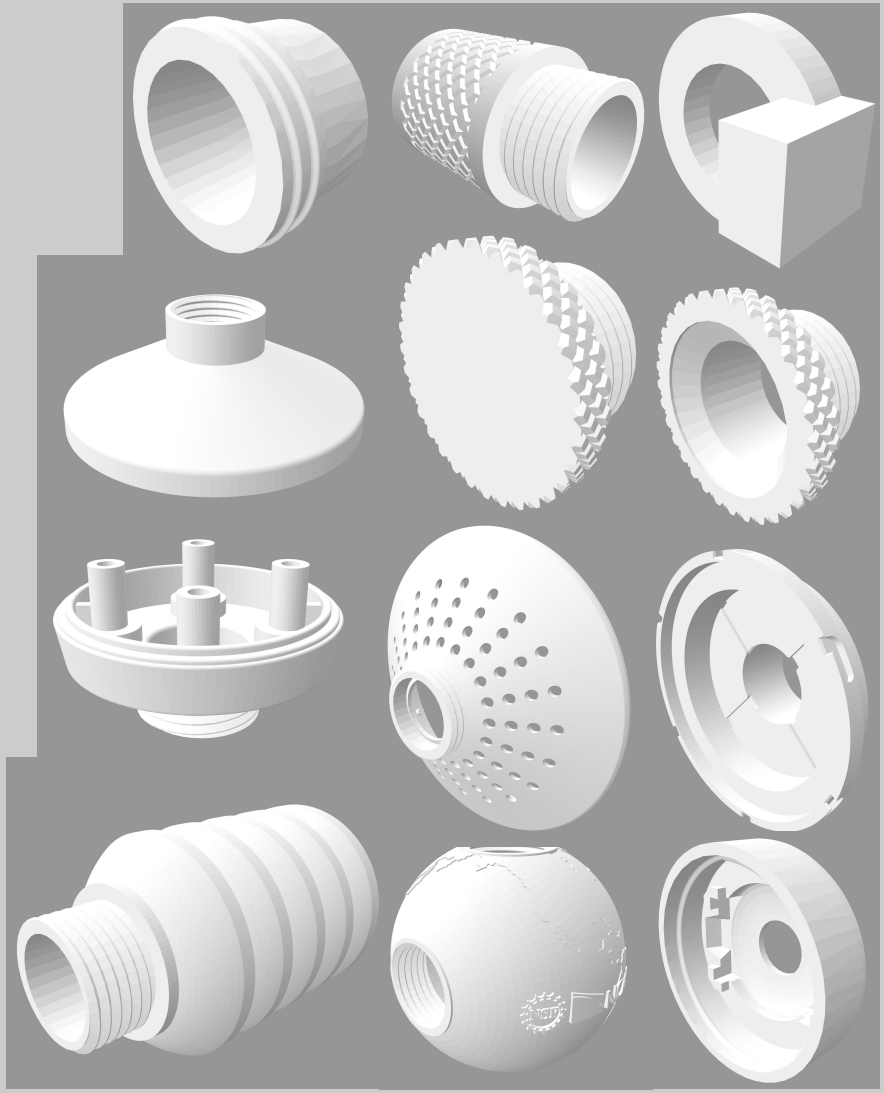
- Except for a few pins, everything runs on Qwiic hubbed connections
- This is a base station, modular on top of this system.
- Divisible into multiple ‘nodes’ running as the same publishing client





Housing and Prints

- 12 required prints
- Users are guided through the printing process
- Printable on easy-to-use, consumer grade printers
- Printed using Ultimaker Cura

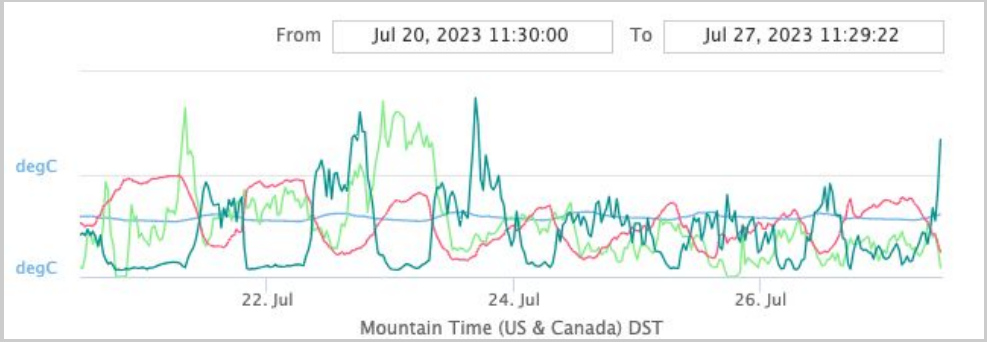


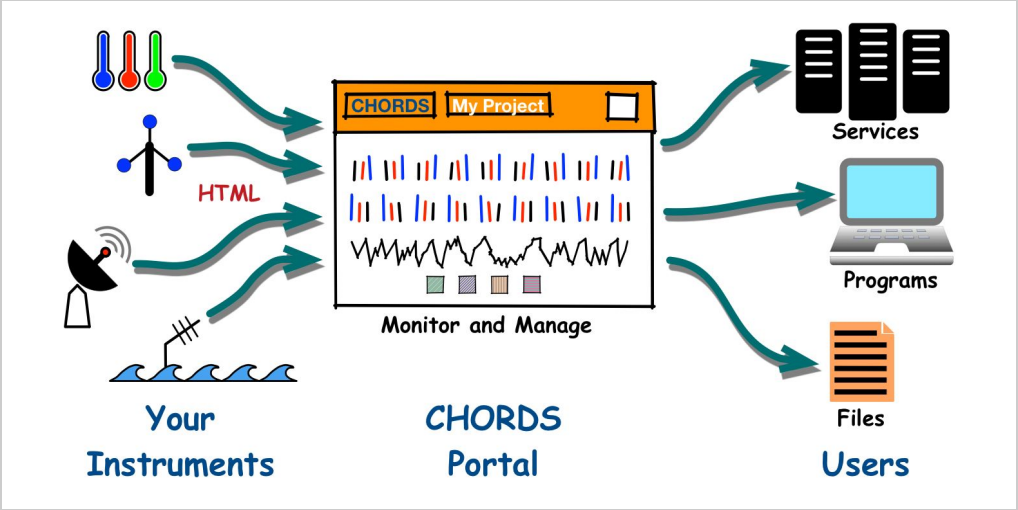
Software

- Built on Arduino
- Uses a lightweight file system to allow for user configuration without entering the codebase
- Allows publishing at custom intervals
- Allows for bidirectional communication between stations and clients

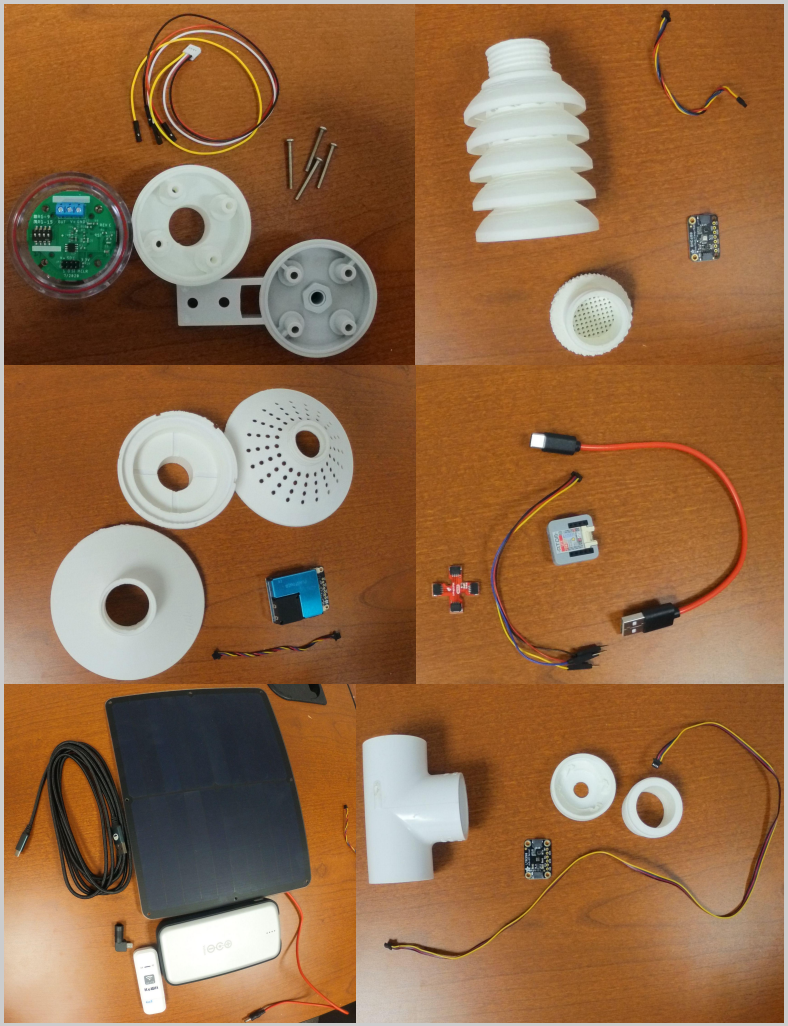
Data Protocols

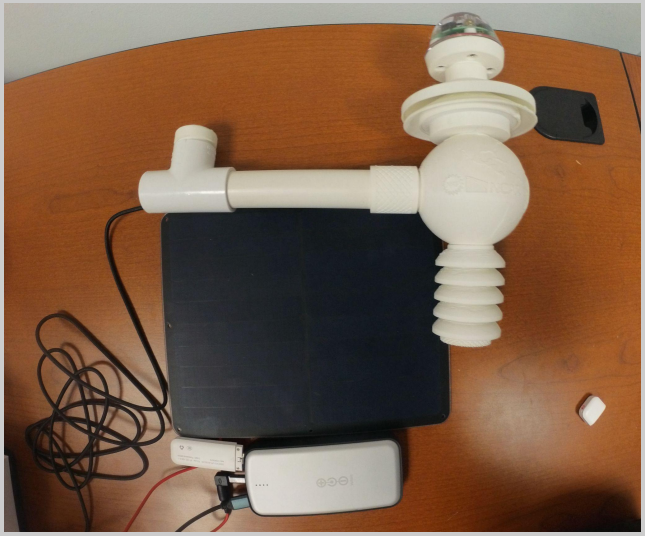
- Data are collected and computed at the ESP32 microcontroller
- Using the onboard cellular modem the data are transmitted via MQTT
- A backend orchestrator functions as the broker, sending measurements to CHORDS (visualization API)
- Data are customized and visualized in CHORDS





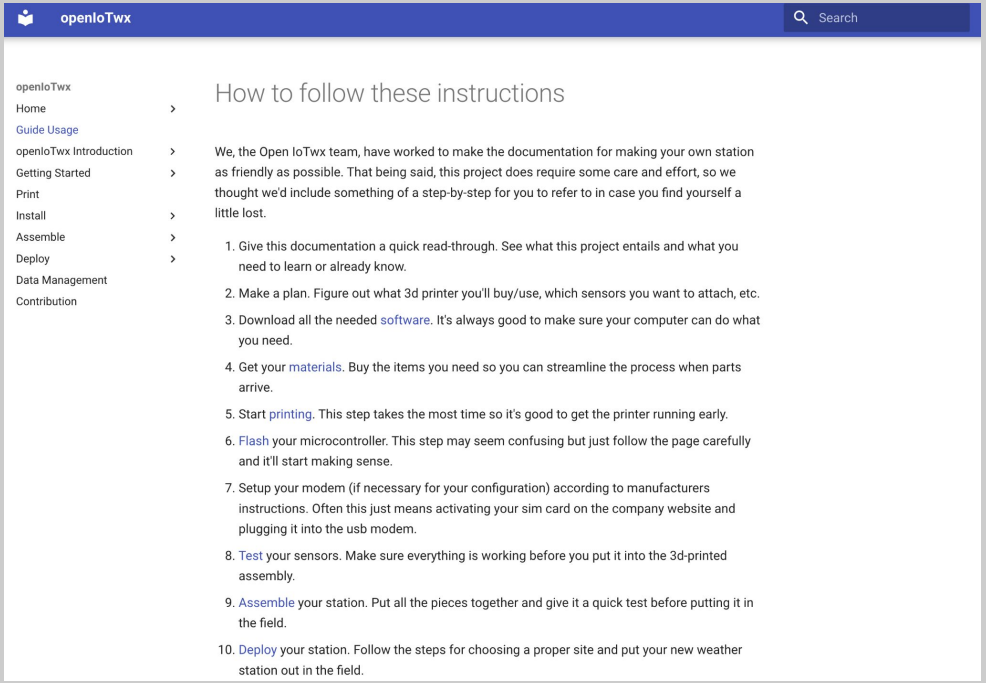
Assembly





Accessibility

- Formatted to minimize jargon
- Static, allowing user download for use in no-bandwidth zones
- Integrating pre-compiled flash and on-the-fly configuration for easier upload



Future Work

- Over the Air updates
- Micropython for easier data testing
- Open source anemometry and method for robust siting thereof
- Large scale station deployment
- Radiation shield calibration
- Adding a hydrologic measurement node and a soil node.
- Publish the papers we're working on

Article title
OpenIoTwx: A Decentralized Automated IoT Weather Station Architecture

Authors
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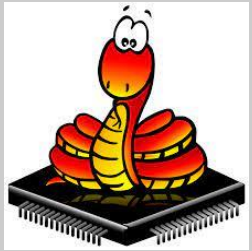
Institutional email address preferred. If you have a Twitter handle, please add it here 'twitter: ....'

Abstract
We present an architecture for the development of an IoT-based weather station, using low-cost System On a Chip (SOC), microcontroller and mobile phone hardware atop the lightweight messaging technology, MQTT. We demonstrate the flexibility of decentralizing weather station operations and meteorological measurements through basic commodity sensor technologies, and show how this approach may encourage development of novel and significantly less expensive sensing techniques that extend what is currently only possible with commercial-grade technologies. Our IoT approach is implemented and discussed through the lens of a reference deployment of a low-cost 3d-printed weather station design.

Keywords
weather station, remote sensing, iot sensing, MQTT



Acknowledgements and Questions

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