An automated cleaning system for pyranometers
Instruments need to be kept clean
Why do we need to clean instruments?

- Reduce uncertainty in measurements
- Better estimation of the cleaning uncertainty
- Reduction in "bad data" being rejected from sites with poor cleaning
- Will be able to clean instruments more often when sites or conditions need it, such as when site works are being conducted nearby
- Determine when we need to clean instruments
- The Bureau of Meteorology is reducing the manned hours that sites will operate at, and in the future these sites will be unmanned
Our Sites are remote

Alice Springs
Cape Grim
Coco Island
Darwin
Sites are geographically distant
Challenges

- No or very low impact on the measurement of irradiance and the climate record with other sensors located in the instrument enclosure where our site is located.
- We need remote monitoring and control of the cleaning device.
- Sites are located remotely with minimal infrastructure and resources.
- One design to suit all instruments classes and scalable to number of instruments.
- Use off the shelf components to keep costs down and faster design work.
- Reliable and durable so as to survive harsh environments between visits.
Some of our instruments to clean
Hardware Design

- Standardised components
- Minimal modification or fabrication
- Environmentally rugged
- Safe
- Scalable
- Simple
- Cheap
Hardware Design
Software Design

- Open source software (Node.js, Node-RED, Elastic Search)
- Easy to program
- Control/display via webpage or mobile app
- Stores data for quality control/quality assurance verification
- Standardised protocols such as SCPI, MQTT
- Build on top of Node.js (Node-RED)
Prototypes

**Pyranometer**
- A ring with three or four water nozzles
- at least two dry air lines, pulsing the drying air

**Pyrheliometer**
- Single water/air line
- The drying air will pulse while drying the sensors

**Pyrgeometer**
- CGR4 etc. with a small dome we can use a single ring with a single water/air line
- PIR which have a large dome we use the dual water/air design of the pyranometer
Controller

- Arduino with relay control boards to drive the required number of solenoids
- Control syntax is SCPI (Standard Commands for Programmable Instruments)
- Physical communications link is either RS232/485 or some Ethernet protocol.
Display/Logging

- A basic web page with monitoring statics and controls for manual cleaning
- Cleaning schedule is initiated via a SCPI command sent via a job scheduler
- Data logging is through the MQTT message broker to an Elasticsearch database
Results and Problems

• What does the cleaning? The low pressure water line or the high pressure water/air mix in the lines before drying?
• What is the affect of various physical design parameters?
• How to get a better clean?
• What is clean?
• Etc …
Further Work

- A more robust working design to test parameters
- Quantitative measurements of cleaning
- Prototype of the software to collect and control the cleaning/display
- Field trials
References

Arduino
• https://www.arduino.cc/

Node-RED
• http://nodered.org/

MQTT
• http://mqtt.org/

SCPI
• http://www.ivifoundation.org/scpi/

Elasticsearch
• https://www.elastic.co/products/elasticsearch
Thank you…

Any questions or queries?

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