



tinyCow Smart Weather Station

Scott Thibault, PhD

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Background

- Founder of StreamLogic company
- StreamLogic
 - Provide tools for building edge-compute solutions
 - Design custom neural-network accelerators
 - Focus on low-resource edge devices
- Seeking to contribute to projects for social benefit
- New to weather domain

tinyCow Goals

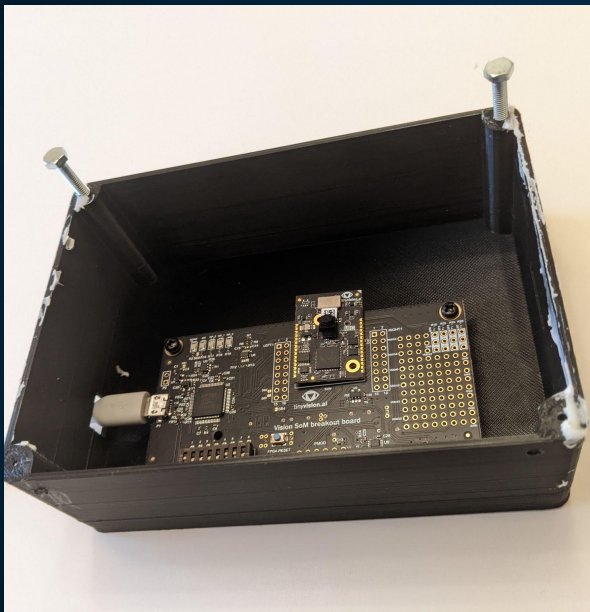
- No moving parts
- Measure core meteorological parameters
 - temperature, pressure, humidity
- Measure rainfall
 - Accumulation
 - High-resolution (sub-hourly)
- Low power
 - > 6 months with battery power
- Low cost (BOM < \$100)

Prototype

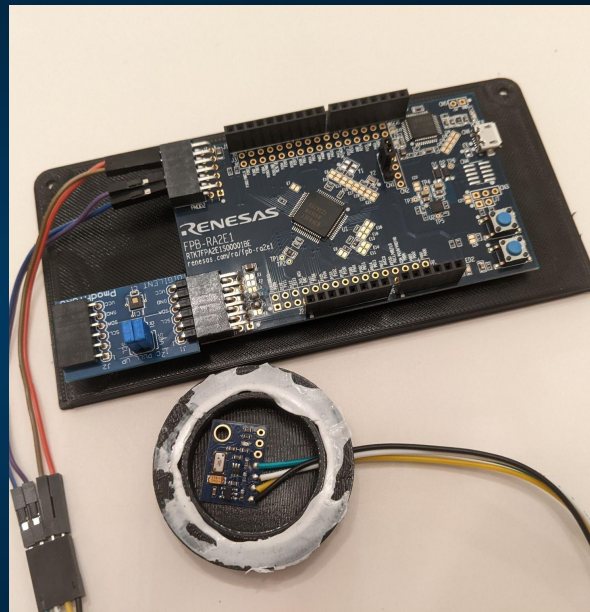


- Simple construction
- No moving parts
- Commodity funnel collector
- 3D printed measurement box

Prototype

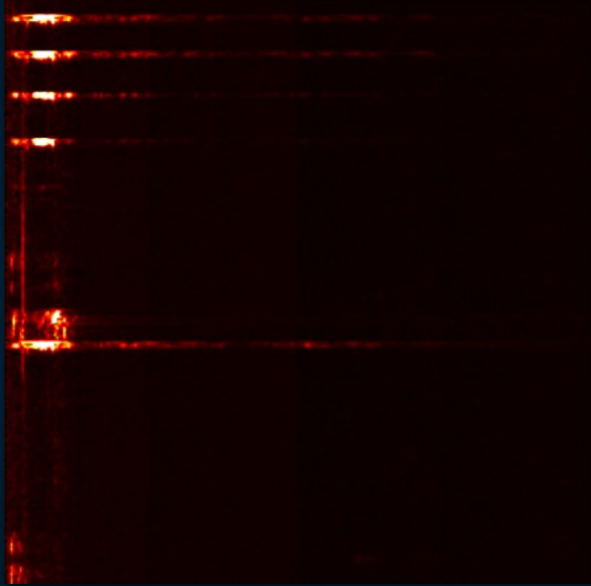


Vision FPGA SoM
camera/mic/audio processor



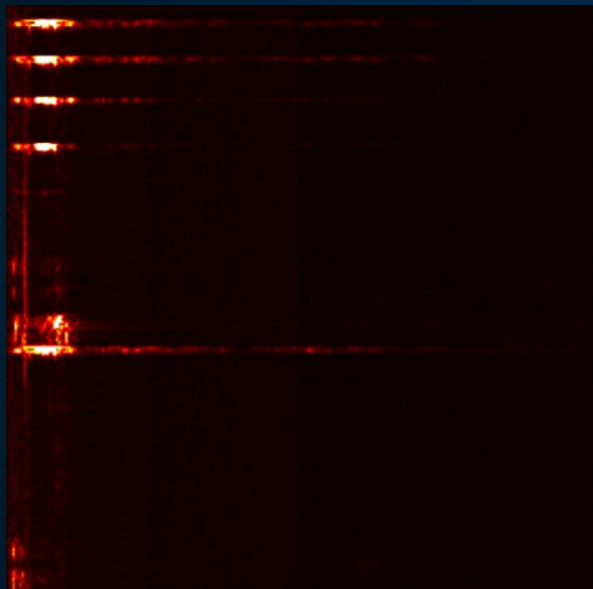
Renesas board and sensors
temperature/humidity/pressure/microcontroller

Rainfall Measurement



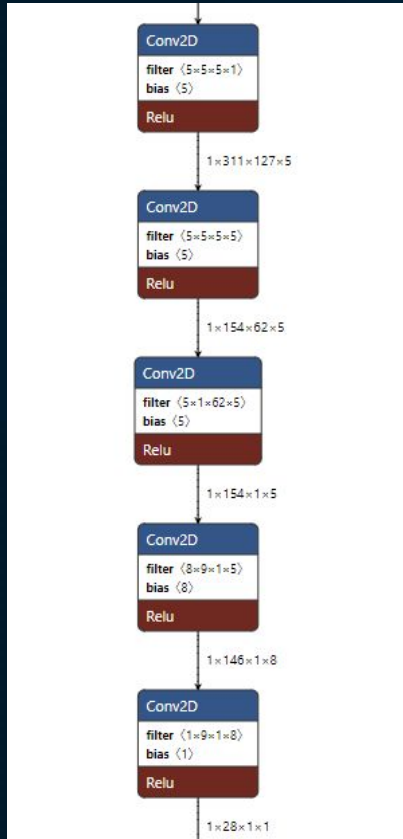
- Convolutional neural network
- Audio spectrogram input
- Predict current rate of rainfall
- Accumulation is sum of many predictions

Rainfall Dataset

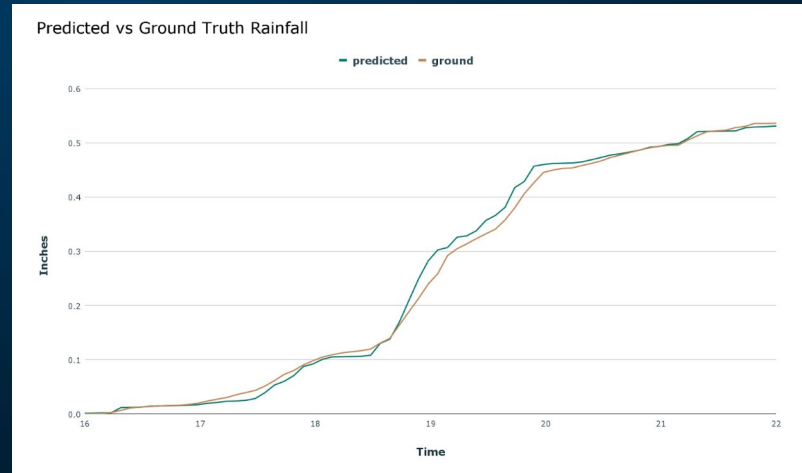


- Collected audio spectrogram images
- High-resolution (minute) ground truth
- 6 hours of training data
- 3 hours of validation data
- 6 hours of test data

Rainfall CNN



- Small network - 2,776 total parameters
- Trained with Tensorflow
- Custom inference engine - 16KB RAM
- Average accumulation error < 1 mm



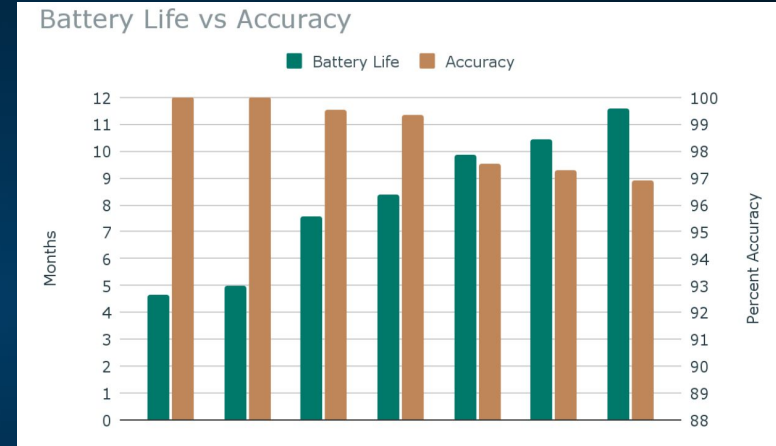
Power Optimization

Function	Current	Duration	Interval	Current/Day
Core measures	5 mA	1 sec	1 min	2 mAH
Rainfall prediction	22 mA	10 sec	5 min	18 mAH

- Core measures (temperature/humidity/pressure) low power
- Audio capture/processing is high power
- Leverage core measures to predict when use rainfall prediction

Power Optimization

- Neural network rain prediction model
- 10 input features calculated from:
temperature/humidity/pressure
- 3 hidden neurons
- Tunable tradeoff of power vs accuracy



Demo