WeatherShark
A light-weight weather station to swim through the skies

Alex J Krejci[1], Jose Manuel Lopez Alcala[1], Mitch Nelke[1], James Wagner[1], Chet Udell[1], Chad W Higgins[1], John S Selker[1]

1 Department of Biological & Ecological Engineering, Oregon State University

H121
241353

Objective + Abstract

Current - Create weather station that is
- Low-cost
- Open-Source
- Deployable with weather balloon

Future
- Sell device
- Uploaded data for public access
- Use data for research

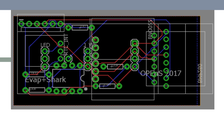
WeatherShark is an open-source, air-deployable weather station. The wind vane form factor has a complete electronics suite embedded including a light weight battery, data storage/communications, sensors, and microcontroller. The system is designed to be light weight (<200 g) and easily deployed (power on to deployment time ~2 minutes). These features, light weight and easily deployed, make it suitable for a variety of applications including aerial deployments (e.g. tethered weather balloon) as well as citizen science projects. The form factor is designed to be attractive while still scientifically functional

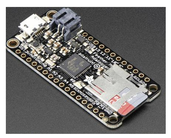
Design Criteria

	Desired	Achieved	Comments
Measurement Capabilities			
Pressure	±1 hPa	±0.12 hPa	BMP280
Temperature	±0.5 ºC	±0.2 ºC	SHT31
Humidity	±2%RH	±2%RH	SHT31
Wind Speed	±0.5 m/s	Testing	Built in house
Wind Direction	±3º	Testing	BNO055
Time	±1 s	Stable for 5.5 days	DS3231
Solar Radiation	Undefined	Research phase	In-house proposed
Rainfall	Undefined	Research phase	In-house proposed
Data + Communications			
Rate	Every 15 s	Up to 5 s	
SD Storage	1 week of data	>> 1 week	MicroSD reader
Wireless	Up to 1 km	Development phase	LORA
Power Management			
Battery Life	>12 hr	15 hr	500 mAh Lithium Poly
Charging	No charging needed	Not Done	80 mA solar panel
Size			
Weight	100g	175g	½ body and ½ electronics
Length	<15 cm	17 cm	3D printed body

Design Details – Version Gamma - Present

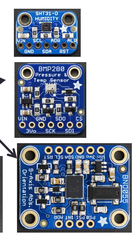
Electronics





Microcontroller
- Featherwing M0 with SD card
- Can easily swap with Featherwing with LORA radio
- Built-in battery monitor, charging circuit, andjst connector

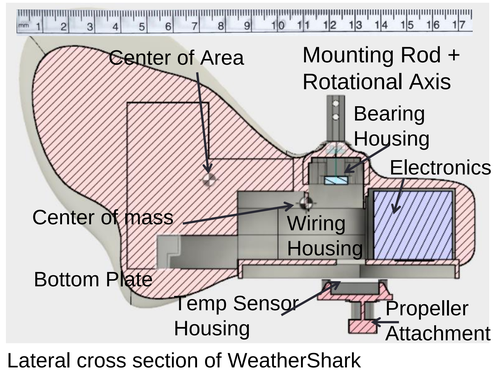
I2C devices
- SHT31 –temperature and humidity sensor
- BMP280 –pressure sensor
- BNO055 – 9 degree of freedom inertial motion unit
  Measures Pitch, Roll, and Yaw
- DS3231 – high precision real time clock



Digital pin devices
- IR transmitter and receiver w/ comparator circuit - measures wind speed
- RGB Neopixel status indicator

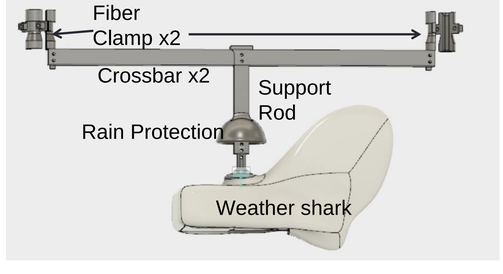
Referencing North
- Typical wind vane is mounted with stable reference to north
- Weather shark uses magnetic and gravitation fields to find north

Housing and Mounting



Lateral cross section of WeatherShark

Not shown – wind speed propeller and temperature sensor louver



WeatherShark with fiber optic mounting attachments

- Center of area is behind center of mass so wind pressure can will rotate device
- Center of mass is behind the axis of rotation, this is compensated by electronics weight
- Clamps grab fibers 1 mm thick – other mounting mechanisms are available

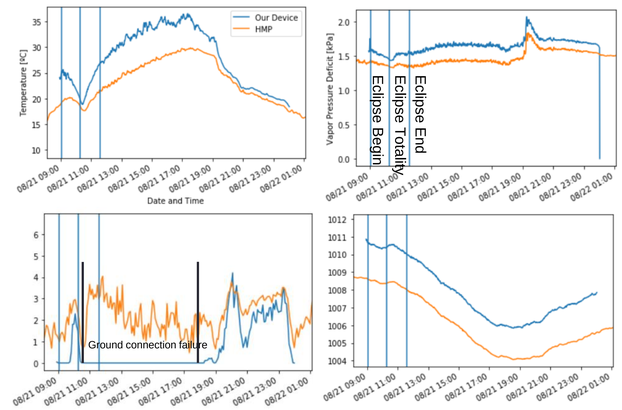
Beta version deployed in the field

To download related files scan the QR Code

Results – Version Beta - Past

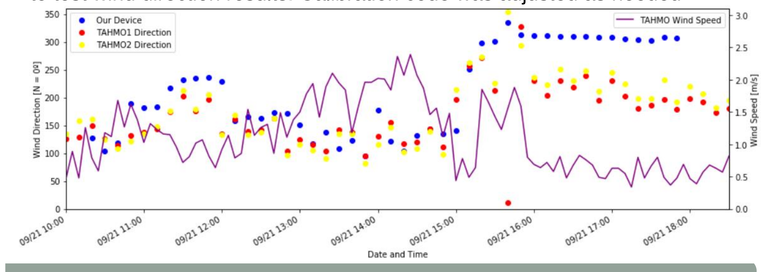
Eclipse Experiment

August 21st – Eclipse passed over Corvallis Oregon. WeatherShark tested against Campbell Scientific HMP and Sonic Anemometer



TAHMO Experiment

Summer 2017 – WeatherShark was collocated with TAHMO weather stations to test wind direction results. Calibration code was adjusted as needed



Version Gamma/Delta - Future

Beta
- Increased ventilation needed for temp sensor
- Wind direction at low speeds is poor – improve rotation capability

Gamma
- Currently in testing phase – Beta problems are resolved
- Reliable sensor data should be available at this point

Delta
- Wireless communications, solar charging, and solar radiation sensing are a priority
- Rainfall - secondary objective.

Beyond
- Reduce form factor by building completely custom PCB
- Scalability using injection molding
- Retailing device for citizen science cloud data collection.

ACKNOWLEDGMENTS

Funding for this research was provided by NSF Earth Sciences division Instrumentation and Facilities program
The author would like to acknowledge the support of Jason Kelley, Hadi Al-Agele, and Thomas DeBell for useful discussions on design ideas.