REIS
RENEWABLE ENERGY & ISLAND SUSTAINABILITY

Wind Sensor Final Presentation

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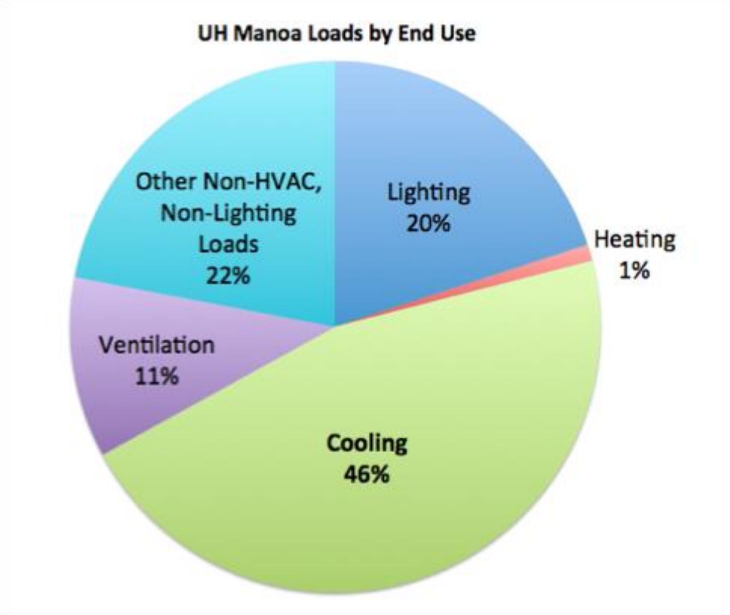
Motivation

The costs of air-conditioning and cooling at UH Manoa are high.

The electricity use for cooling uses 46% of the energy on campus.

Knowing wind speed and direction can aid in the planning of buildings for natural air ventilation to lower energy use from air-conditioning.

Affordability



Project Background and Goals

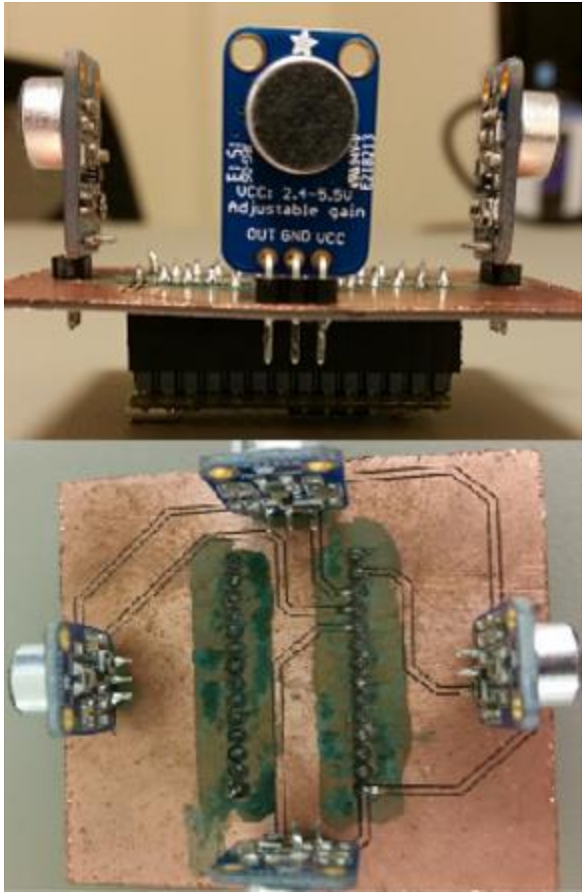
Objective: To build a wind sensor that is low cost, small, reliable, durable, and has no moving parts that detects 2D speed and direction.

- Current design uses four microphones
- Implements Teensy with Cortex M4

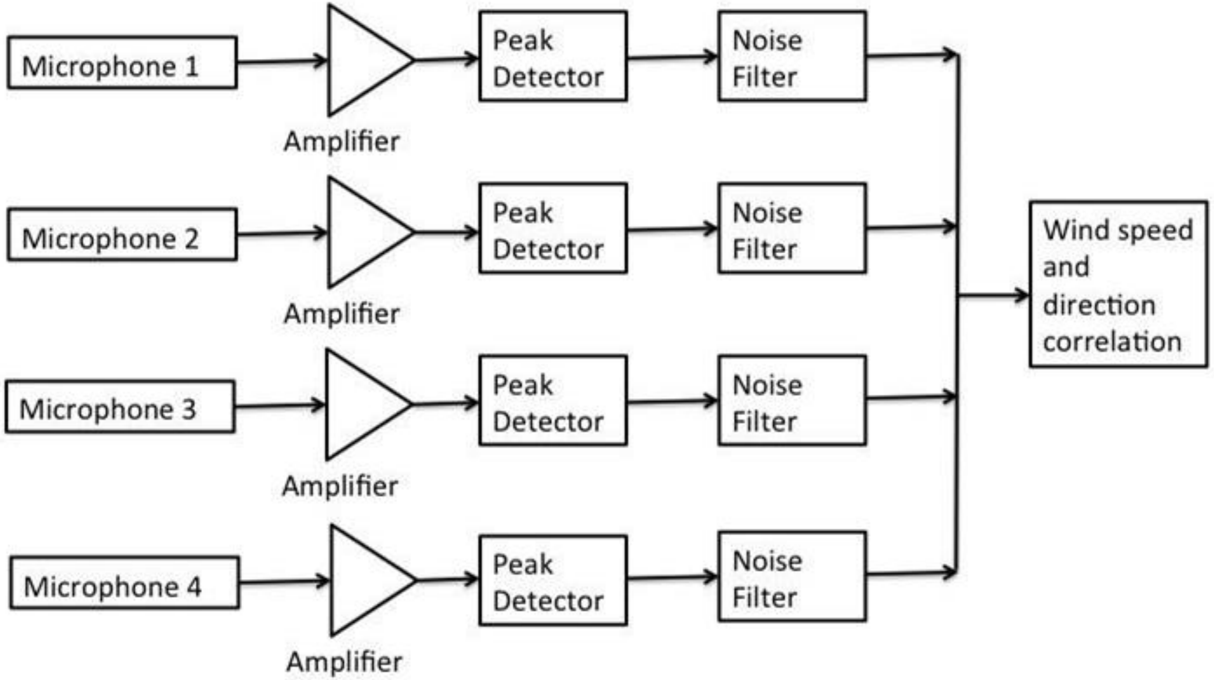
Goals:

Short term: Have a working wind sensor that can detect 2D wind speed and direction

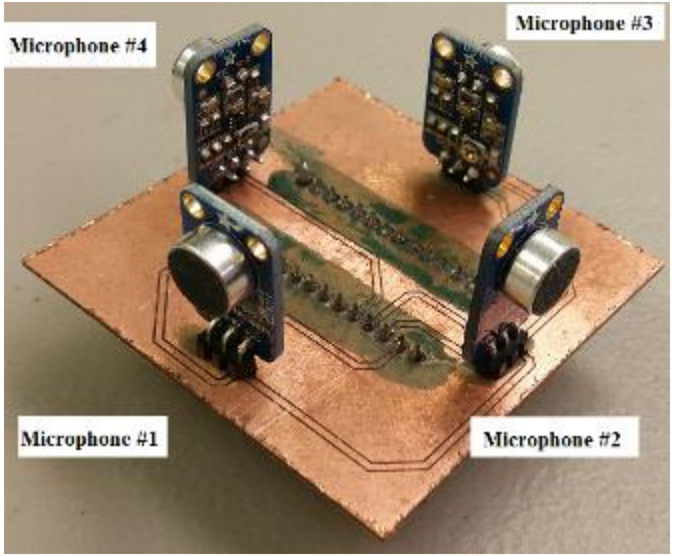
Long term: Integrate to weatherbox to put on rooftops around campus



Block Diagram - Overall System



Description of Overall Design



- Uses the amplitudes from the four microphones and our developed algorithms to get the predicted wind speed and direction
- Relies on taking a ratio between the microphones

Costs:

4 x $6.95 for microphone and amplifier breakout board = $27.80

1 Teensy 3.2 = $19.95

Total cost = $47.75

Testing

Raw analog testing

Used Teensy analog output to record data for 1 minute

Single microphone:

Amplitude and angle tests

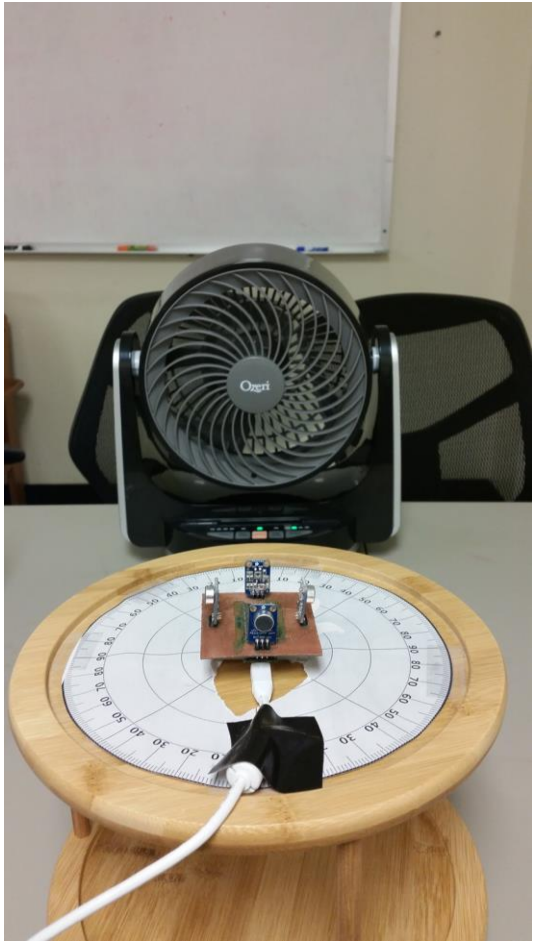
Four microphones:

Amplitude and angle tests

Wind Speed & Direction Testing

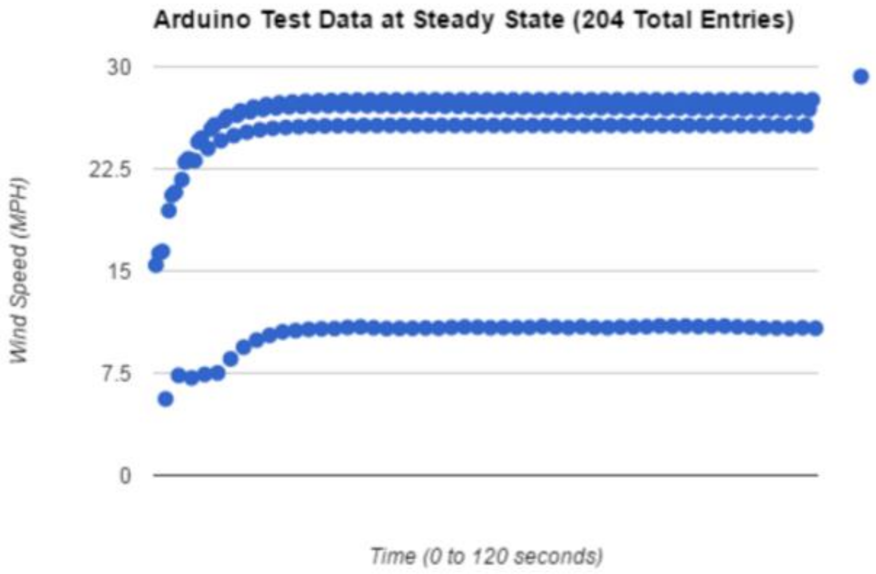
Used analysis from analog testing to create algorithm

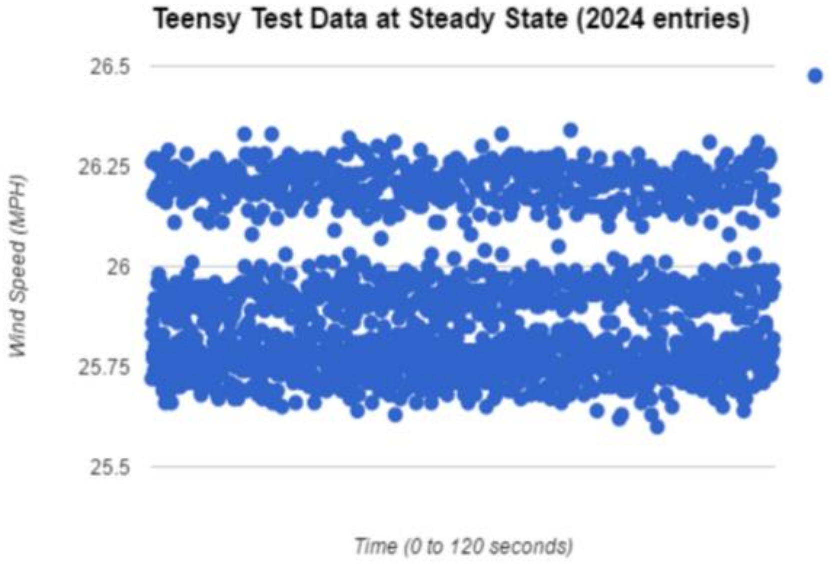
Arduino gets analog data, then processes it and outputs the predicted wind amplitude



Quantitative Testing

- Ran steady state value test for 2 minutes
- Can see that Teensy can take samples at almost 10x faster (wanted at least 4x)
    - 204 samples vs. 2024 samples
- Can see that Teensy data is inaccurate (at least 1 microphone should give smaller values)





Problems and Solutions

Problem: Disagreement on solution to past issues

Solution: Sought input from previous members

Needed something that had a faster processor than the Arduino

Solution: Researched different microprocessors, chose Teensy

Problem: Inexperience with Teensy

Solution: Looked up tutorials

Problem: Everyone relatively new to the project

Solution: Reached out to Andy & Daisy for mentoring

Final Status of Project

Completed this semester:

- Learned how to use the Teensy
- Redesigned system from the ground-up on Teensy
- Designed a testing PCB board that can test the four microphones on Teensy
- Tested RMS chip

Began recalibration

- Documentation - by end of next week all new methodologies will be posted
- Report will be rewritten in a systematic and easy to read fashion
- Team learned valuable skills and tools for future

Remaining Problems

- Still having trouble with anemometer
  - Using settings specified by manufacturer
- Porting code causes errors
  - Syntax errors, corrupted library & drivers
  - Analog conversion value might be different
- Need to qualitatively prove that Teensy works
  - Currently unable to accurately map wind speed with Teensy
  - Need to be able to compare with Arduino

Future Improvements

Use an RMS to DC converter chip in hardware for improved efficiency
Build housing for the wind sensor

Look more into the frequency domain

Filter random outdoor noise

Recalibrate with anemometer via UART

Power source

Wireless transmission of data

Implement Cortex M4 microprocessor directly onto board

Questions?