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Small-Scale Wind Power Prediction

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Small-Scale Wind Turbine Prediction

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Introduction

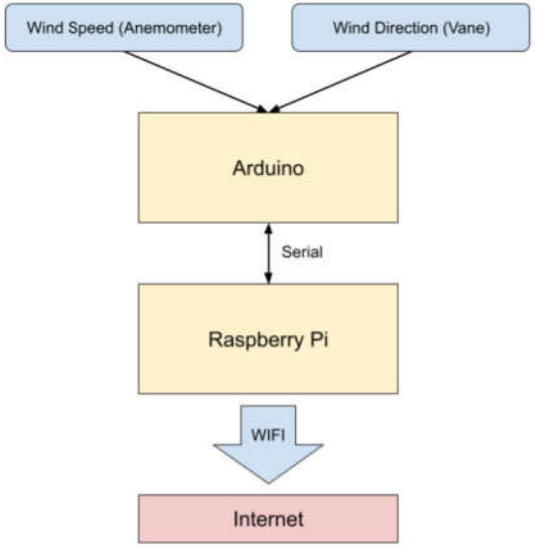
- Inconsistent generation from wind turbines has become the primary hindrance to widespread adoption.
- Small wind turbines are a power solution for remote installations or personal power needs.
- Accurate prediction for these generation sources, particularly in non-ideal environments, would expand the use of wind turbines.

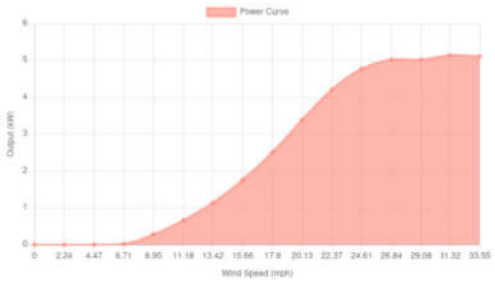
Goals

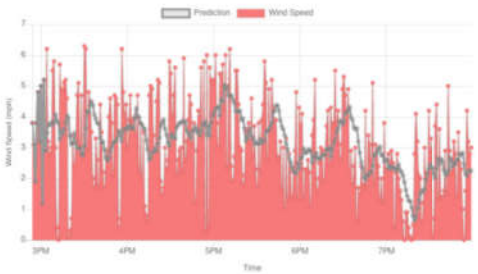
- Develop the foundations for small-scale wind power prediction in non-ideal environments.
- Identify an algorithm for generation prediciton on the hourly and next day basis.

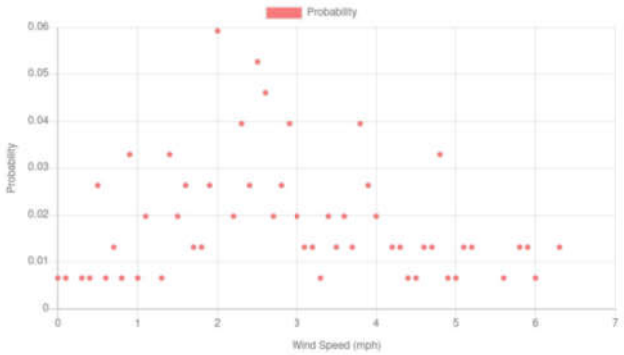
Approach & System

- Installation site should have a local weather station for prediction, including a anemometer and wind vane.
- Sparkfun Weather Station Kit provides an anemometer and wind vane to an Arduino microcontroller.
- A RPi connects to the Arduino to store data to database and provide website platform for analysis.
- A wind turbine with a known power curve was selected to compare weather results against.









Proposed Prediction Algorithm

- Approaches indicated in research on the second and hourly timescale, using linear prediction and 10-minute averages, could be combined with proportional weighting to predict generation for second, minute, and hourly timescales.
- Weibull probability distributions on the per-day basis could be used for predicting generation on the daily timescale, potentially in conjunction with the algorithm for smaller timescales.

Conclusions

- Of the two sites that data was collected from, on the day data was collected, neither had sustained wind speeds to generate consistent theoretical power.
- Further experimentation should include a physical wind turbine to verify algorithms against.
- The study did not look into the creation of power curves, and this has a large impact on prediction.