

### Goal

- ❑ Design a device that can sense utility pole characteristics (tilt, orientation, wind speed, etc.) to try and predict utility pole failures before they occur
- ❑ Design a communication scheme that can route utility pole characteristics back to a base station for evaluation and data processing

### Motivations and Objectives

- ❑ Out of service utility poles can lead to power outages, which can leave thousands without power
- ❑ Downed lines are also extremely hazardous to pedestrians
  - ❖ Peoria, IL, 2015: 44,000 outages from damaged utility poles due to freezing rain and wind gusts [5]
  - ❖ Branford, CT, 2015: 4,165 outages due to damaged utility poles [6], [7]



### Research Challenges

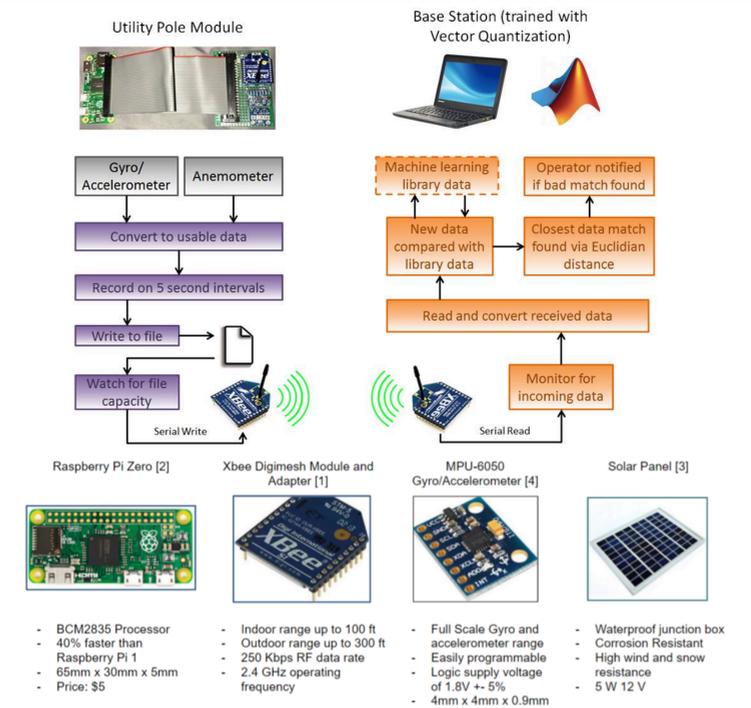
- ❑ What 'characteristics' of poles are important to structural integrity?
- ❑ How can data be transferred to a base station?
- ❑ How can the device be powered?
- ❑ Is the device feasible on a large scale?
- ❑ How to protect the device from weather and damage?

### Acknowledgement

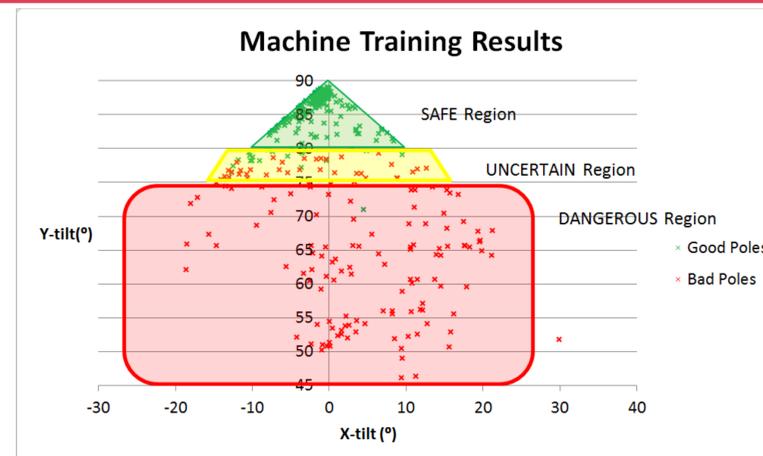
We would like to thank our advisor, Prof. Pompili, the ECE capstone organizer, Dr. Godrich, as well as Lutron for pledging their financial support to our project

### Methodology

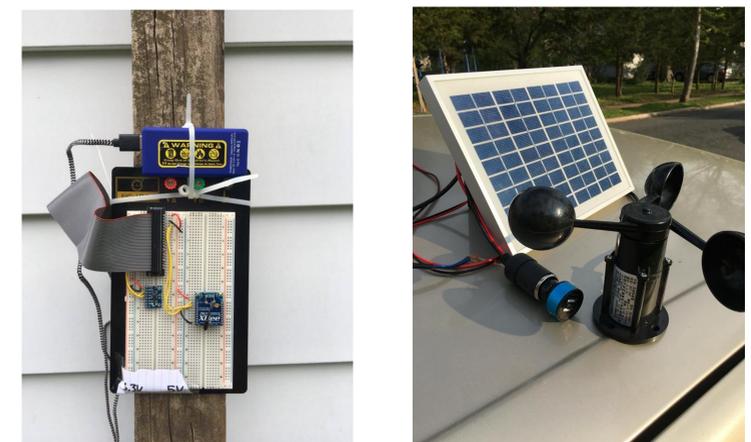
- ❑ A Raspberry Pi system is set up containing orientation sensors; it sends its gyroscopic data wirelessly via an Xbee to a nearby computer
- ❑ The nearby computer uses k-means based machine learning to analyze gyroscopic data and detects any flaws with the orientation of the poles
- ❑ If issues arise, the user will be notified, and the machine learning algorithm will take appropriate measures to address the undesirable values
- ❑ Solar Power apparatus is used as a power source



### Results



- ❑ Machine training reveals three major regions that should be used to classify poles: Safe region, Uncertain region, and Dangerous region
- ❑ Preliminary Testing results are promising – Pole data is successfully read and transferred to the base station for further analysis



- ❑ Device runs sustainably on solar power apparatus
- ❑ Wind speed testing and other characteristics can easily be added to code at will
- ❑ Would need to mount and test on actual poles for "true" data

### References

[1] "XBee® 802.15.4." *Multipoint Wireless Networking OEM RF Module*. Digi, n.d. <<http://www.digi.com/products/xbee-rf-solutions/modules/xbee-802-15-4#specifications>>.  
 [2] Upton, Eben. "Raspberry Pi Zero: The \$5 Computer - Raspberry Pi." *Raspberry Pi Raspberry Pi Zero the 5 Computer Comments*. Raspberrypi, 26 Nov. 2015. <<https://www.raspberrypi.org/blog/raspberry-pi-zero/>>.  
 [3] Details taken from <http://www.eco-worthy.com/catalog/>  
 [4] "MPU-6050 | InvenSense." *MPU-6050 | InvenSense*. InvenSense, n.d. <<http://www.invensense.com/products/motion-tracking/6-axis/mpu-6050/>>.  
 [5] <http://www.nhregister.com/article/NH/20150729/NEWS/150729411>  
 [6] <http://www.postcrescent.com/story/news/2015/12/28/sunday-crash-causes-power-outages-we-energies/77967192/>  
 [7] <http://www.pjstar.com/article/20151228/NEWS/151229499>