

Motivation

The Santa Cruz Greenwharf Project utilizes a wind turbine to generate renewable clean energy. During high winds the wind turbine is known to vibrate. Under normal operating conditions the vibrations are inconsequential, but during severe winds the vibrations have damaged the bearings of the turbine. Utilizing accelerometers we were able to monitor the vibrations of the wind turbine.

Device

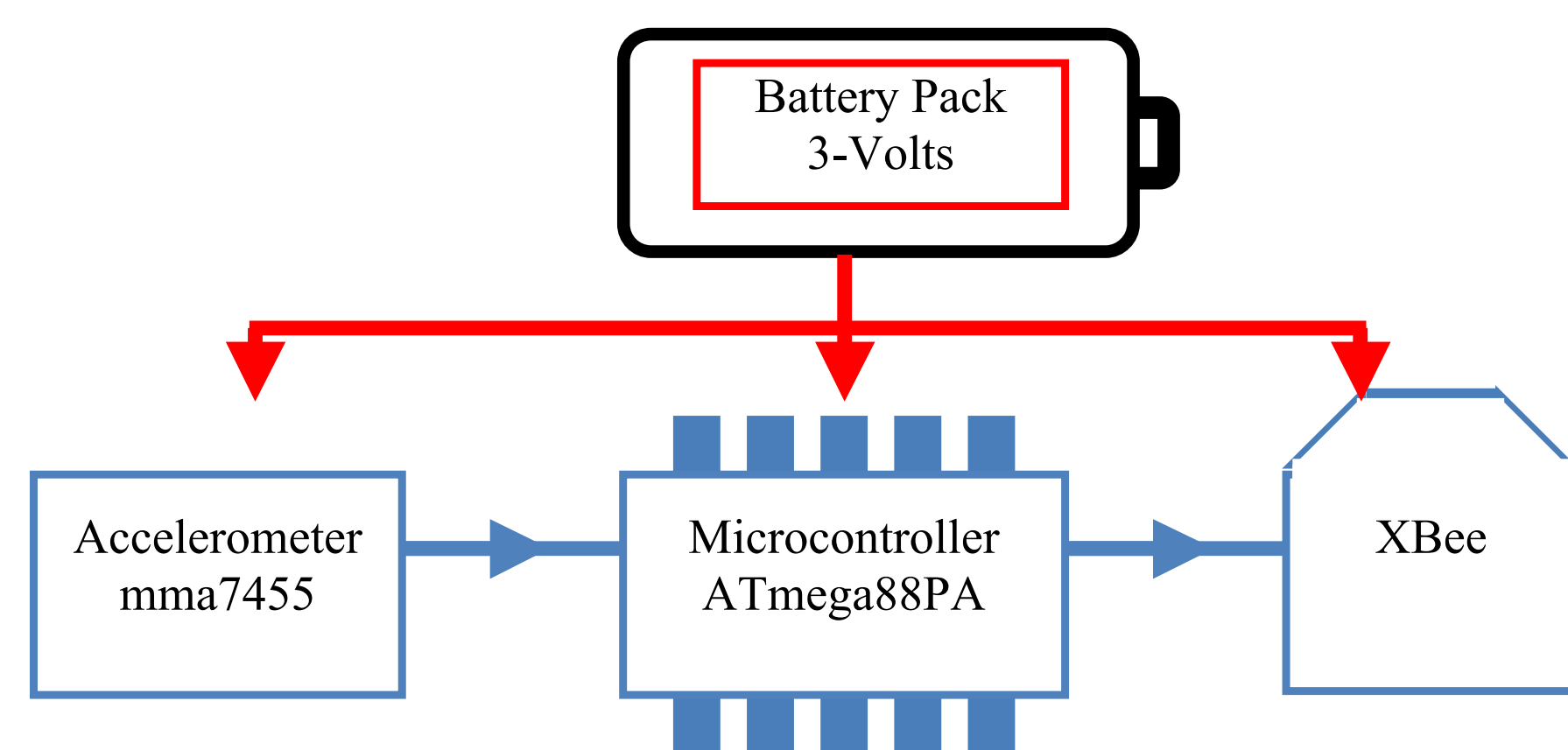


Figure 1: Illustrates the top level design of the accelerometer device. Image created by Jarred Moore

The components of the device work together to transmit measurements to a computer.

- The accelerometer measures the movement of the wind turbine.
- The microcontroller reads the measurements from the accelerometer.
- The XBee chip transmits the data from the microcontroller to the computer.

Accelerometer

- The system uses three mma7455 accelerometer chips.
- Each accelerometer measures the X Y and Z axial movement of the wind turbine.
- The accelerometers are positioned at the top, middle, and bottom of the wind turbine.
- Using the three devices we can determine the amplitude of the vibrations.

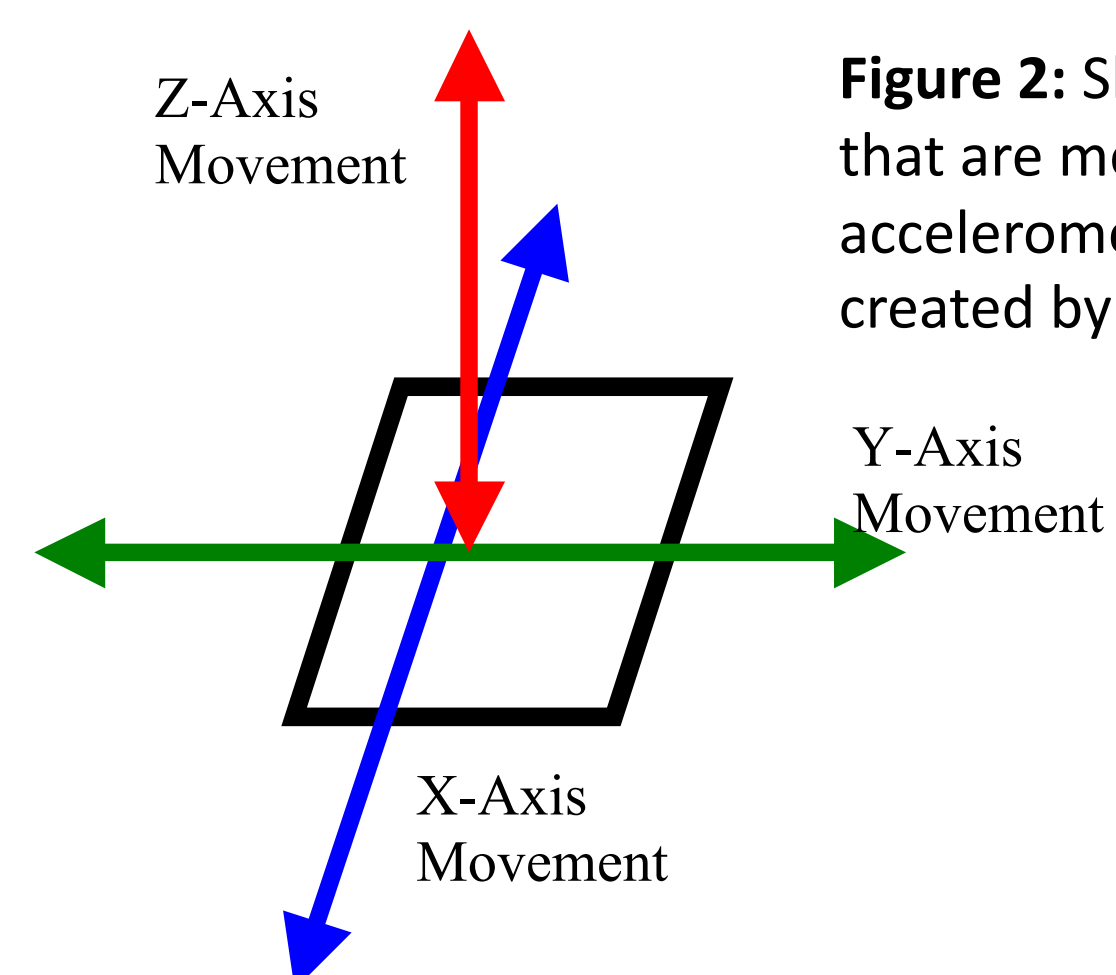
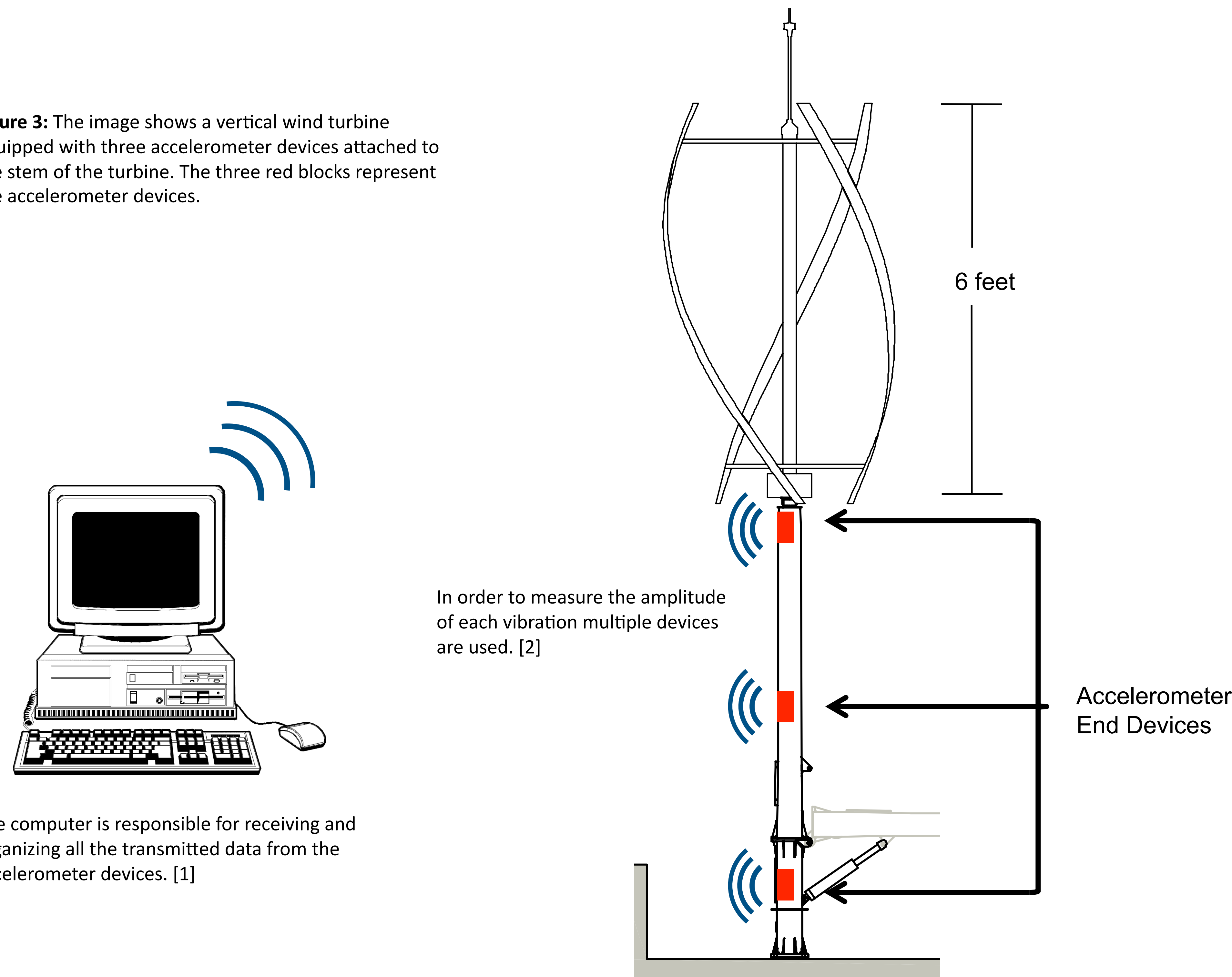


Figure 2: Shows the axes that are measured by the accelerometer. Image created by Jarred Moore.

Wind Turbine Application

Figure 3: The image shows a vertical wind turbine equipped with three accelerometer devices attached to the stem of the turbine. The three red blocks represent the accelerometer devices.



In order to measure the amplitude of each vibration multiple devices are used. [2]

The computer is responsible for receiving and organizing all the transmitted data from the accelerometer devices. [1]

Device Design

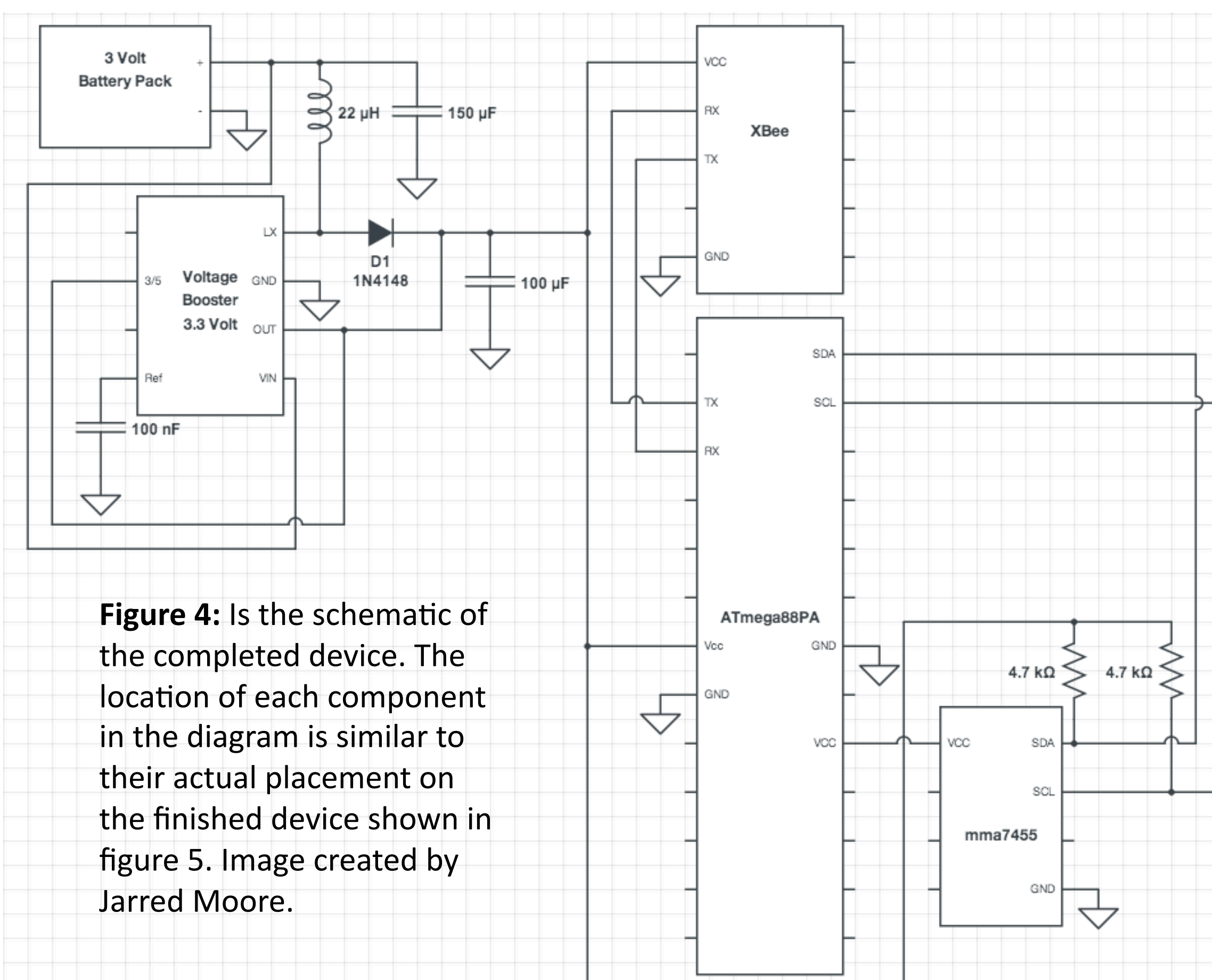


Figure 4: Is the schematic of the completed device. The location of each component in the diagram is similar to their actual placement on the finished device shown in figure 5. Image created by Jarred Moore.

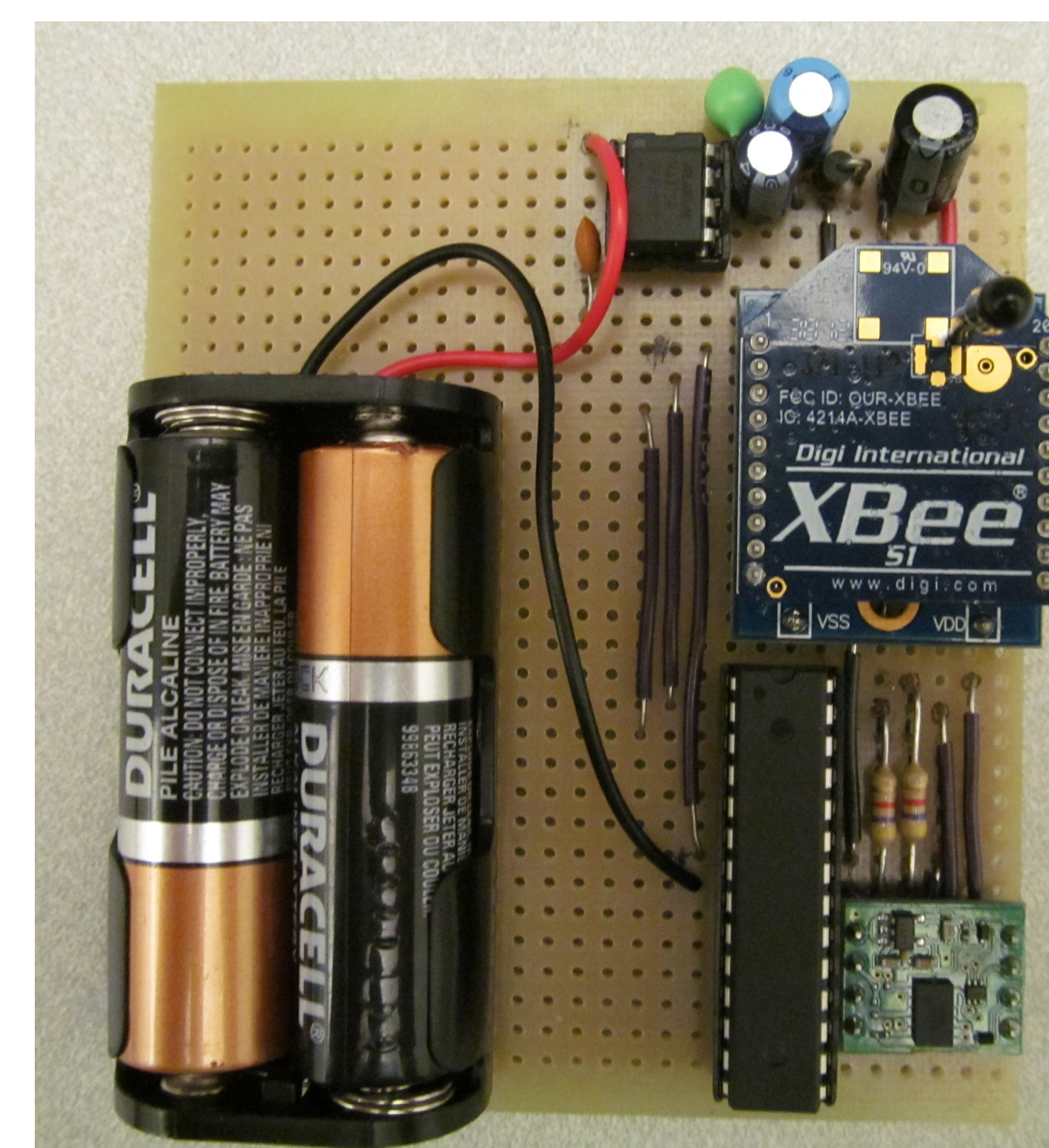


Figure 5: Is a picture of a completed device. Picture taken by Jarred Moore.

Microcontroller Logic

The ATmega88PA microcontroller performs the following procedure to obtain data from the accelerometer.

- Initialize all devices.
- Send write command to accelerometer's X Y and Z addresses.
- Read X Y and Z data from accelerometer.
- Store received data in a buffer.
- Transmit data stored in the buffer.

XBee Communication

The XBee chips are radio devices used to transmit data from the turbine to the computer.

- The chip connected to the computer is the coordinator.
- All other chips are called end devices.
- Each end device is responsible for transmitting the accelerometer data to the coordinator.

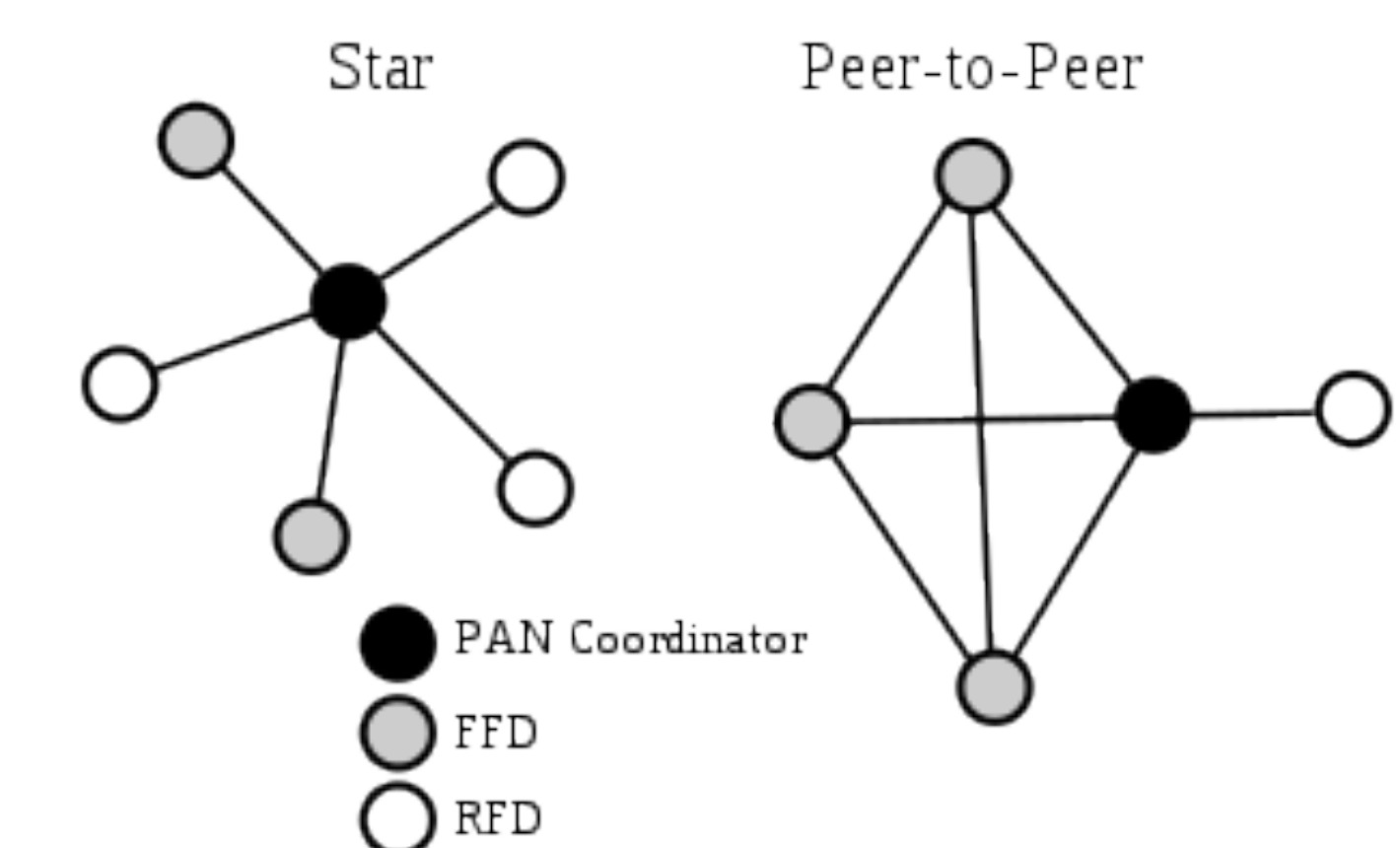


Figure 6: Shows two different configurations of XBee devices. Our project implements the star configuration. [3]

Future Work

Having the devices created is the first step towards extending the lifespan of a wind turbine, but more work needs to be done.

- Install devices on wind turbine.
- Collect and generate a graphical representation of data.
- Analyze data and identify the destructive wind conditions.

References

- 1) Author Unknown. Online, www.anthonymoreino.com, accessed 8-4-13.
- 2) Author Unknown, *qr5 - Vertical Axis Wind Turbine*. Online, www.quietrevolution.co.uk, accessed 7-28-13.
- 3) Author Unknown. *Radio Devices*. Online, www.wikipedia.org, accessed 7-28-13.