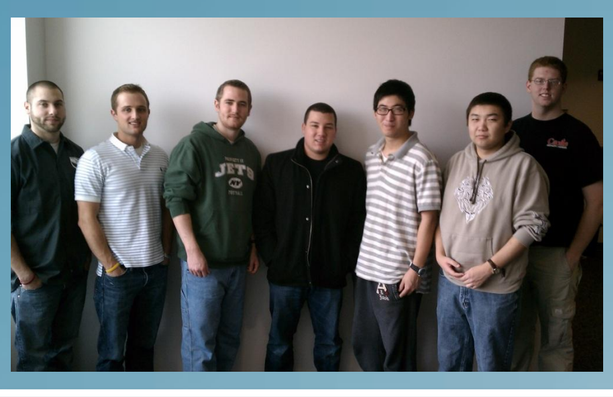
P12401
2011-1/2011-2

Wind Energy Collection to Energy Bank (WECEB)



Team Members
From left to right: Philip Lazeski (ME), Franklin Zelinger (ME), Erik Hilley (ISE), Justin Walti (EE), Zeng Shou Liu (EE), Jargalan Nermunkh (CE), Bradley Godshalk (ME)

Vince Burolla (Team Guide)
Dr. Edward Hensel and
RIT ME Dept. (Sponsor/Customer)

Mission Statement: To design, build, test, and deliver a system that will use a wind turbine to collect and transmit energy, and demonstrate controlled storage. Other Multidisciplinary Senior Design (MSD) teams and RIT students will consume the energy captured and stored within the system, specifically through the Charging Dock Module being developed by another MSD team (P12402).

Motivation: The Sustainable Energy Systems for Education (SESE) family of projects in the MSD program. The goal for the SESE family of projects is to design and deliver interchangeable sustainable energy solutions for use by future senior design teams and undergraduate engineering class projects in the KGCOE, beginning fall semester 2013. This project, WECEB, is one of the first projects defined in this groundbreaking family.

Additional Information: Visit the website https://edge.rit.edu/content/P12401/public/Home for complete project documentation.

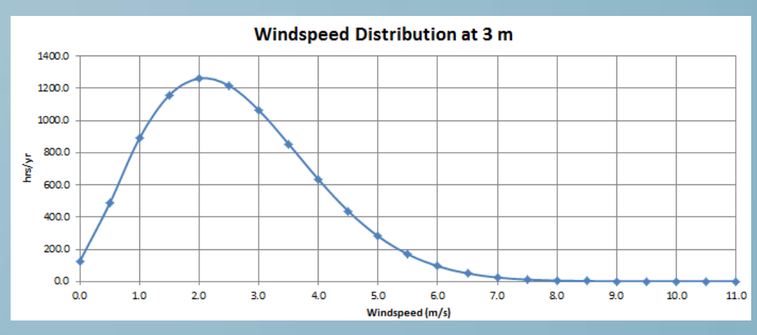
Selected Design:
- Nature Power 400 Watt Wind Turbine with MPPT
- Amstron 12V / 75Ah Deep Cycle VRLA Battery
- Team-designed Wind Turbine Stand
- Team-designed PCBA for battery & system monitoring

Nature Power Wind Turbine

Amstron Sealed Lead Acid Battery

Wind Analysis: In order to fulfill P12402's Charging Dock requirements of charging 8 Land Vehicle for Education (LVE) batteries, the wind turbine needs to provide an average of 20.64 Watts of power.

With the Rochester average wind speed at 3 meters being 2.59 m/s, the wind turbine will output roughly 25 watts, deeming it a well scaled turbine.

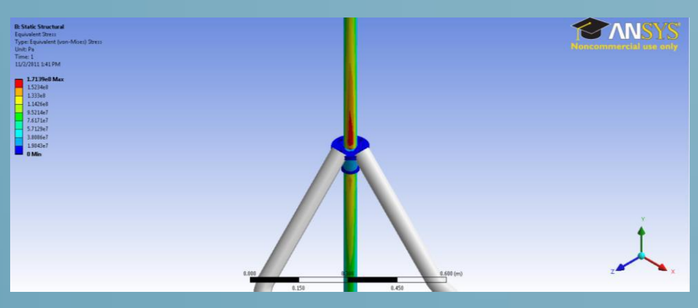


Turbine Stand: Designed to be easily transportable, has pinned legs that will allow them to rotate up towards the center mast. Quick and simple assembly.

FEA Analysis of Turbine Stand: The stand can exceed the survival speed of the wind turbine itself.

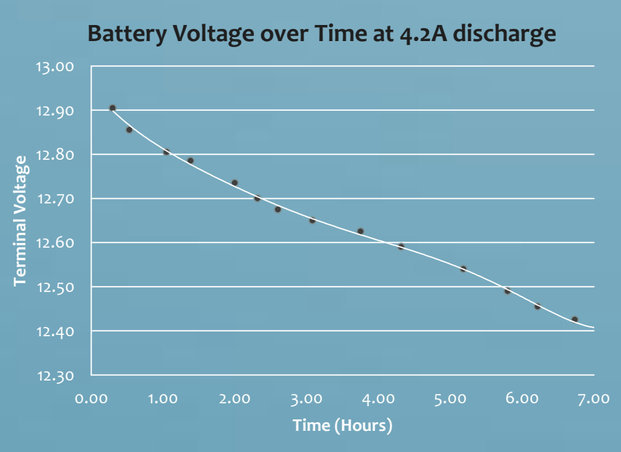
In wind of 70 m/s, the stand sees a max stress of 171.4 MPa when yield is at 203.9 MPa.

Fabricated Turbine Stand



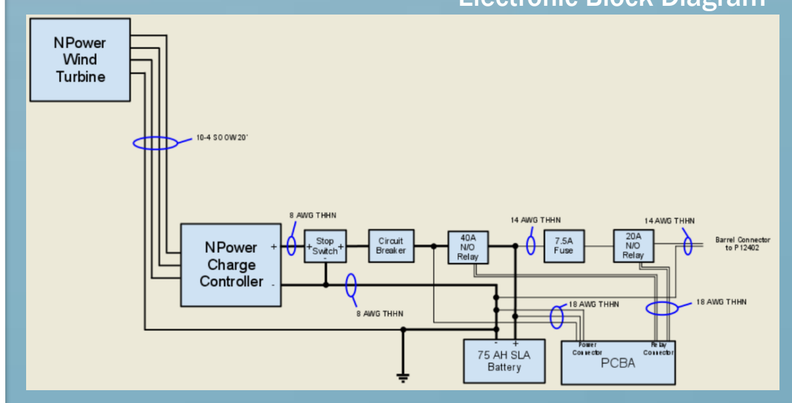
Battery: Need at least 68 Amp-hour (Ah) capacity, chose a 75 Ah Amstron unit.

Chart shows time needed to discharge battery from 100% to 60% state of charge for typical P12402 consumption. These numbers coordinated with MCU on PCBA to display correct LEDs.

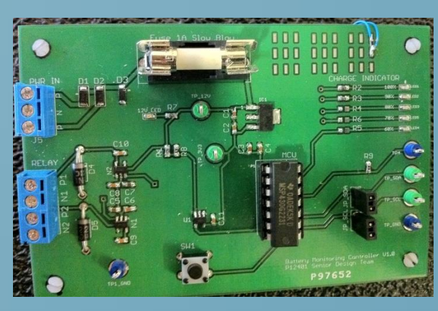


Goals of Battery Monitoring System (PCBA):
- Prevent damage to the Amstron battery from over-discharging
- Continuously charge the Amstron battery and provide power to the Charging Dock Module (P12402) simultaneously
- Protect Charging Dock Module from high inrush current
- Display the state of charge of the Amstron battery from 60% - 100% with LEDs, so P12402 team will know how many LVE batteries can be charged
- Modularity, so future teams are able to utilize spared pins off the Microcontroller (MCU)

Electronic Block Diagram



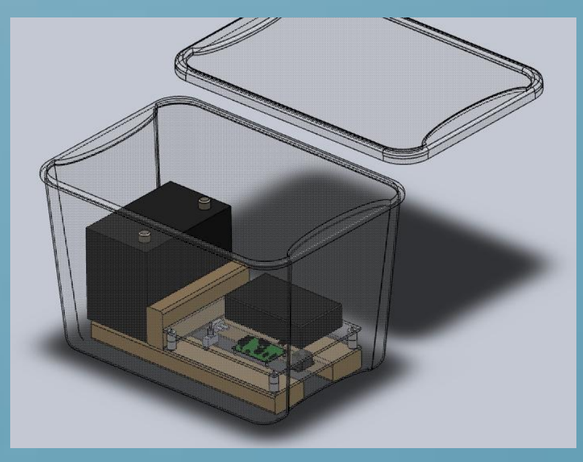
PCBA



Battery Enclosure: Needs to be weatherproof, but will not face prolonged exposure. Thus watertight seals are not necessary.

Wooden 2x4's used for frame, acrylic sheets used for mounting electronics.

Houses Amstron battery, turbine MPPT controller, PCB board, accompanying relays and switches.



Results/Conclusions: Indoor wind testing proved insufficient; outdoor wind testing resulted in minimal sustained winds. Used a hand drill to verify turbine power output. At 1000 RPM, turbine produced 51.88 watts; beyond the 20.64 watt average needed.

Systems integration between the WECEB team and P12402 proved successful. LVE batteries were charged and the PCBA displayed the correct LEDs based on the sealed lead acid battery's state of charge.

Future suggestions...
- Use a battery designed from more sustainable technology. A company, Aquion, is manufacturing Sodium-Ion batteries that are 100% recyclable.
- Have a larger energy bank to store more power.
- Expand power generation by adding more renewable energy systems.

Special thanks to:
Vince Burolla
Leo Farnand
Dr. Edward Hensel
Prof. Mario Gomes
Prof. Robert Stevens
Prof. John Wellin
Prof. George Slack

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