Portable Wind Turbine

WALTER SCOTT, JR. COLLEGE OF ENGINEERING
COLORADO STATE UNIVERSITY

Mohammad Alajmi • Yahya Al Kindi • Eric Ellis • Meghan McNulty

Electrical and Computer Engineering • Mechanical Engineering at Colorado State University

Advisor: Professor J Rockey Luo

Background

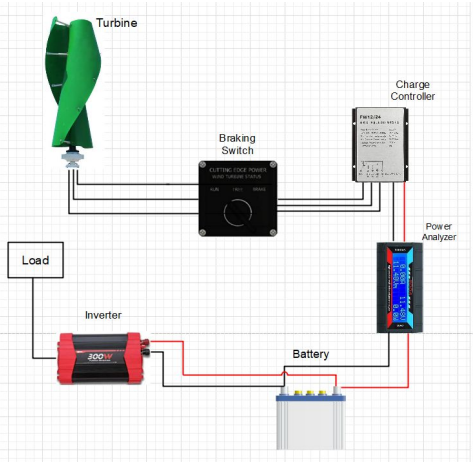
One million Americans live in an RV full-time and many more use RV's or other smaller SUVs for recreational purposes. Most of the vehicles use non-renewable energy like propane to run their generators and off-grid appliances. The integration of our wind turbine onto their vehicle will help reduce the users carbon footprint. Further expansion of this device could help the estimated one billion people in the world who suffer from power outages.

Problem Statement

Around one billion people in the world live in places where they suffer from power outages. Even in the United states people suffer from power outages more than any other developed country mostly because of natural disasters. Also, some campers and RVs seek to have a clean energy source to power their appliances

Goal: The goal of this project is to create a proof-of-concept for an affordable, convenient, and vehicle mounted wind turbine for those who wish to reduce their carbon footprint.

System Overview



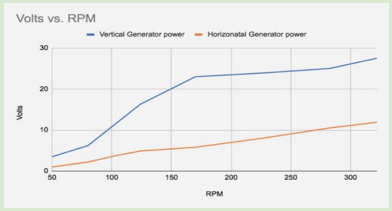
Electrical Testing

Horizontal VS vertical

On this test, we are comparing between the horizontal and vertical wind turbine generators in order to decide which one will be used. We used a 9 fixed speeds to determine the RPM vs Voltage measurements and below is the final result.

Rated Power

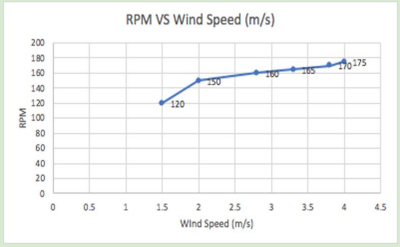
Vertical (300W) Horizontal (400W)



- Based on the graph, we chose the vertical wind turbine since it produced more AC voltage.

RPM VS Wind speed

On this test, we are to see the corresponding RPM with different wind speeds. This test are done while the vertical position of the turbine on top of the vehicle. Figured that there's a good RPM corresponding to the wind due to the wind.

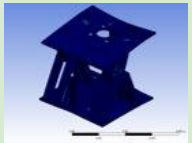


Power Output

- Start wind speed ~ 2 m/s
- DC voltage around~ 14V (Which is the breaking voltage of the charge controller)
- DC Current at around 1 Amps with a 4 (m/s) wind speed

Mechanical Testing

FEA analysis was conducted on the attachment hardware before construction. All results were well below the yield points for structural steel.



Tested attachment hardware. Drove it in the storage/ horizontal position under 45mph.

The locking mechanism was tested in the engaged and disengaged positions.

1- Vertical position: Power generation

2- Horizontal position: Storage and transportation

Project Challenges

- **Vibration**: When the turbine is the vertical position and running the turbine causes the roof rack and attachment mechanism have significant vibration.
- **Power generation**: For consistent power, the turbine must be in an open space and have a wind speed of 10 m/s which is the average wind speed in Fort Collins.And that should produce and est of 50W and total of 1200WH per day.
- **Space consideration**: The turbine and hardware must be compact enough for the customer to be able to store other goods.
- **Safety**: A braking system must be in place to safely ensure stopping of the turbine blades. The attachment mechanism must be durable enough to prevent the turbine from falling and causing harm or damage during use or transportation.
- **Affordability**: Of our $3,800 budget, we spent $1,500. However, to increase our efficiency higher quality components must be purchased. This will cause our production costs to increase.

Conclusion

Project Improvements

- Create a custom wind turbine and rack for the space.
- Redesign the attachment hardware to utilize the hitch and side support to minimize vibration.
- Professional manufacturing of attachment hardware and electrical circuits.
- Power the transition between horizontal and vertical turbine positions for easier use.
- Better gear box system and for the generator and blades for the turbine to produce more at low wind speed

Next Steps:

- Improve gearbox to increase power generation.
- Provide additional support to the roof rack to minimize vibrations.