The Airbenders' Wind Turbine

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Introduction

Our goal was to prepare future UVU teams for the Collegiate Windmill Competition sponsored by the Department of Energy. To do this we built a competition-scale turbine according to competition rules.

We subdivided the project into three important design areas: blades, electrical, and nacelle.

Blades

+

Electrical

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+

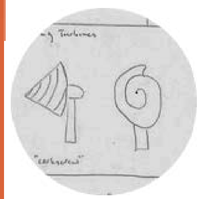
Nacelle

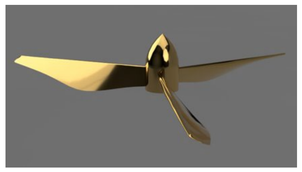
Objectives

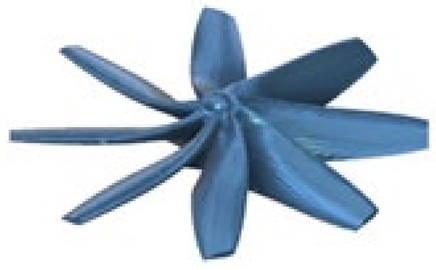
- Design and assemble a fully functioning scale model of a wind turbine
- Create a design that begins producing power at the lowest possible wind speed
- Achieve the highest power output with respect to wind speed.
- Explore innovative designs

Research & Development

- Used competition rules to establish product specifications
- Utilized morph charts, screening & scoring matrices, and prototyping techniques to evaluate over 80 designs







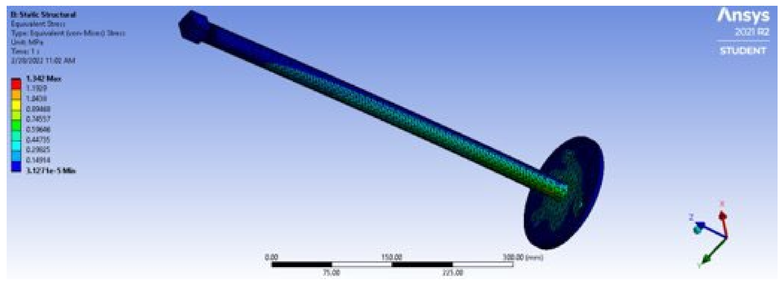
- Implemented sensors to detect motor rpm, voltage, current and power outputs
- Developed a multi-path load to optimize power depending on windspeed and blade rotation (rpm)
- Breaking system that helps control the blade rpm based on power generated

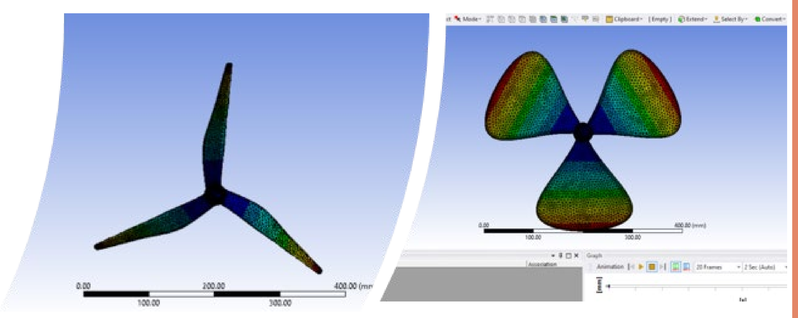
Innovative Approaches

- Continuous Variable Planetary system (CVP) instead of a gearbox
- Material was SLA resin for high durability

Analyses

- Tested lift and drag turbines thoroughly against cut-in speed, max voltage, and rpm criteria in a wind tunnel
- Performed failure analyses using ANSYS, Altair, Fusion360, SOLIDWORKS and some hand calculations





Fun Facts:

- Lift style turbines are more commonly used in large scale industrial wind farms and utilize long, narrow blades

- Drag style turbines feature wider blades and are mainly used for small scale energy production

Results

Conclusion

- Following the design process, we were able to build a functioning wind turbine according to the DOE-CWC guidelines.
- It provided a great learning experience for interdisciplinary engineering students.

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