Variable Voltage Charge Controller

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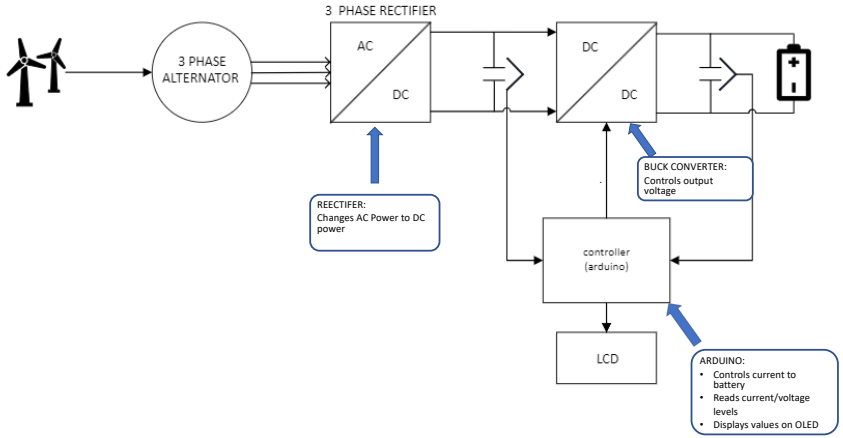
Abstract

The goal of this project is to create a charging system for 12V batteries on a sailboat. We aim to move away from using fuel systems, solar panels that may not operate as frequently as we need, and from the high-cost, high-precision market systems for wind generation. because there is not always enough wind for high power charging, our system will operate in a broader range of conditions to consistently supply a small trickle charge to the battery bank. The system will take power in from a small-scale Wind Turbine (WT) and convert it to charge the shipboard battery. The system will also have controls to monitor and control the power flow and stop the battery from overcharging. The focus of this project is to use a variable power source (the WT) to charge a battery.

Overall Design

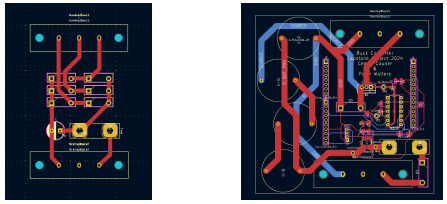


Key Features

- Diode Rectification
- Buck Converter to reduce DC voltage
- Arduino-based control loop to adjust converter PWM signal
- OLED display to present user information

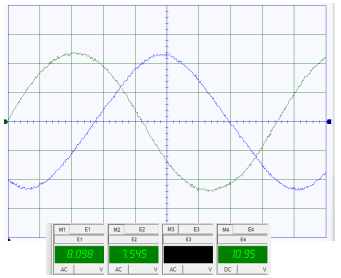
Objective

To make a more affordable way to charge boat batteries when away from the dock in order to prolong battery life and power essential systems.

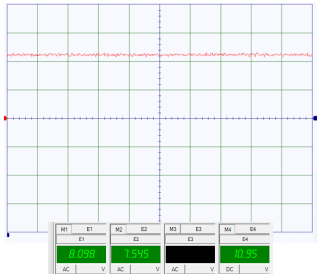


PCB designs for rectifier (left) and converter (right)

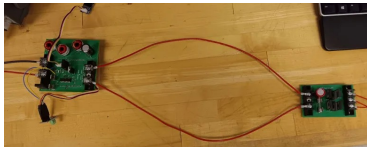
Results



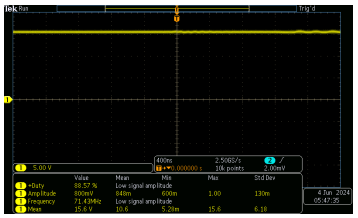
2-phase output of alternator



DC output of Rectifier



Both subsystems connected in tandem



New DC output from Buck Converter

Future Direction

Next steps:

1. Mechanical Implementation
2. Install on the boat

Acknowledgements

Xichen Jiang, Amr Radwan, John Lund, Reza Afshari

References

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M. S. Davis and M. R. Madani, "3D-Printing of a Functional Small-Scale Wind Turbine," 2018 6th International Renewable and Sustainable Energy Conference (IRSEC), Rabat, Morocco, 2018, pp. 1-6, doi: 10.1109/IRSEC.2018.8702850.

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Capstone Project
Electrical & Computer Engineering Program