NanoGrid

A Path to Energy Efficiency and Renewable Energy

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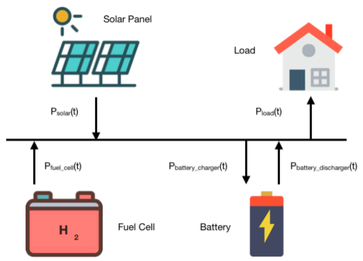
Introduction

Energy sustainability and the aging grid infrastructure in the United States are two important subjects at the crossroads between politics, economics and technology. One proposed solution to these two issues revolves around the concept of an islanded microgrid which we named the NanoGrid. Therefore, the objective of this work was to build a small prototype that emulated the behavior of the NanoGrid (nGrid) and tested different control strategies.



Schematic of a NanoGrid

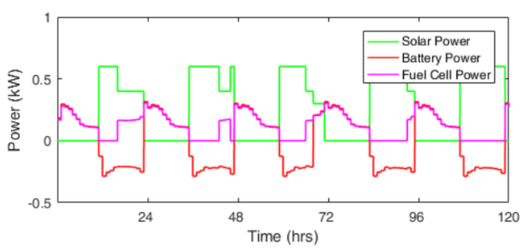
Overview

NanoGrid

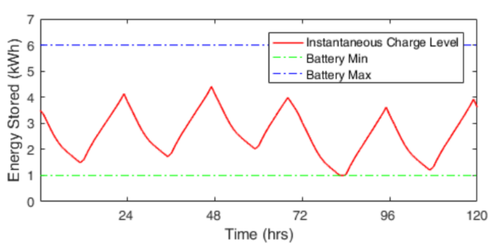
- Goal: create a more efficient controlled house
- Solar panel, fuel cell, battery, and a load (fan and autonomous car)

Autonomous Vehicle

- Small scale car represents the autonomous electric vehicles of the future and is part of the nGrid load



Simulated Solar, battery, and fuel cell contributions

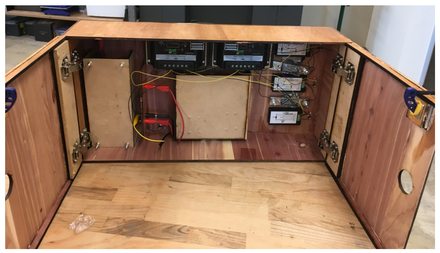


Simulated charge and discharge of the Battery

NanoGrid Controller

- Represents the electrical components of a home
- Comprised of a solar panel, fuel cell, and battery
- Uses integrated sensors to measure and display voltage, current, and power generated or consumed by each component
- Compact and user friendly

Front of nGrid controller



Inside of nGrid controller

Autonomous Vehicle

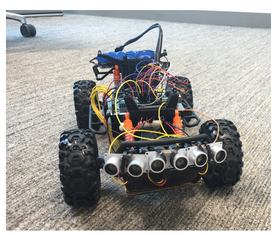
Acts as a load to the nGrid via wireless charging

Main Components:

- Arduino Mega
- Accelerometer
- Laser Range Finder
- Ultrasonic Range Detector
- GPS

Able to read sensor data and detect obstacles in path

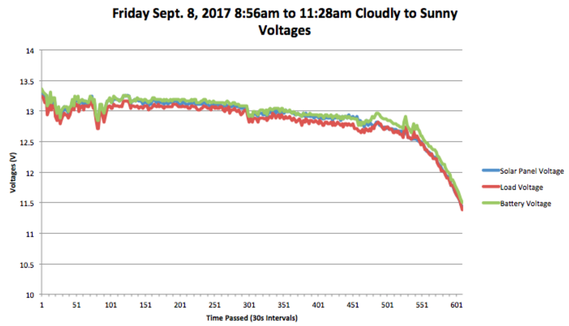
Second chassis built to optimize space and efficiency



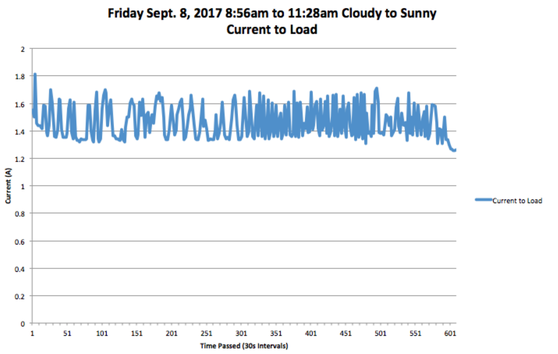
Autonomous vehicle design with off-the-shelf chassis

Lab-built chassis of the autonomous vehicle design

Results

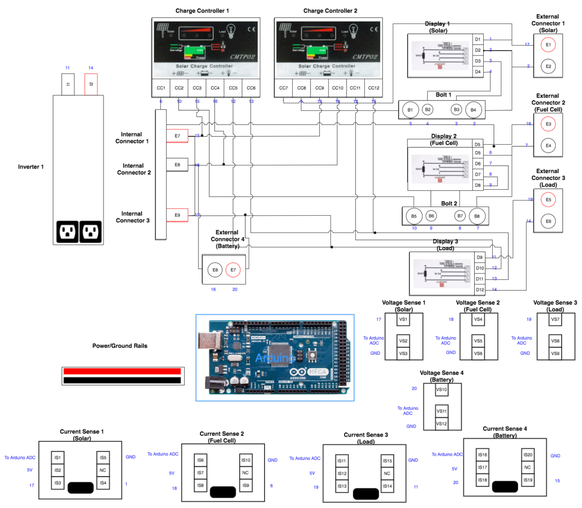


Voltages throughout the day



Current throughout the day

- Voltage and current values trend downward as the sun moves rises and sets
- Voltages of solar panel, load, and battery are very similar throughout the day
- Currents fluctuates in a small intervals



Schematic of nGrid controller

Conclusion

We were able to design a prototype that emulates an nGrid. It is able to divert power from the battery to satisfy the load. By using solar, we were able to charge the battery while powering the loads showing the possibility of creating an off-the-grid house using this system.

Future Works

- Add a fuel cell (or any DC power supply) to allow control of the nGrid
- Take data throughout an entire day (24 hours) and improve on design depending on data taken
- Implement solar axis tracking to the solar panels to improve on solar panel efficiency
- Allow the car to use GPS and move to given GPS coordinates
- Use designed chassis

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