The Autonomous Efficient Generator

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Introduction

The goal of this project is to improve the efficiency of generators by using a set of electrical storage elements along with a control system which starts and stops the generator depending on the state of these electrical storage elements. One application of this project is to configure an automobile to efficiently provide electrical energy capable of powering a sump pump and other electrically powered devices during emergencies, power outages, and special off-grid applications.

Motivation

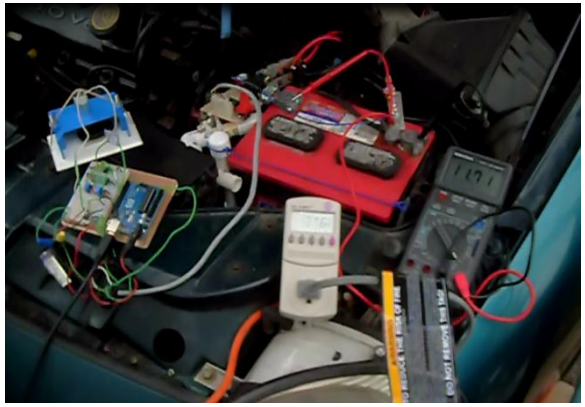
Many people were without power after Superstorm Sandy, but installing a standby generator to handle such emergencies proves too expensive. Using an automobile as an electric generator can provide a lower cost, widely-available alternative. And with proper automatic start/stop control of the auto engine, fuel consumption during the power outage is minimized.

Challenges

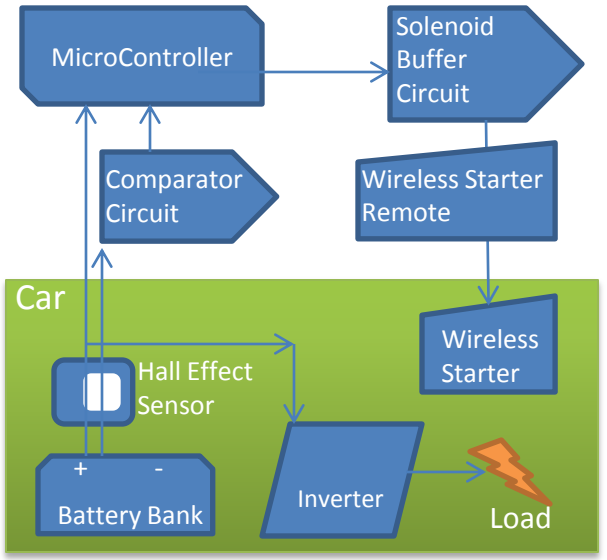
- Developing a safe power distribution system
- Designing the device to remotely start the car
- Minimizing losses along the power lines to the inverter
- Creating a control system that functions without faults
- Acquiring accurate readings for analysis by microcontroller
- Learning the limitation of our system in terms of what devices can and cannot be powered.

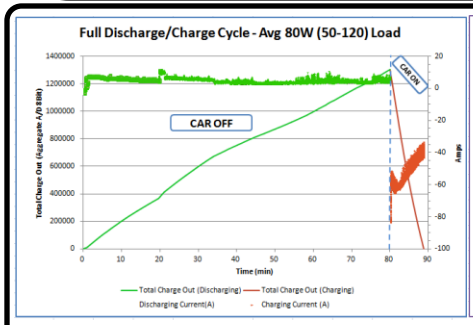
Design

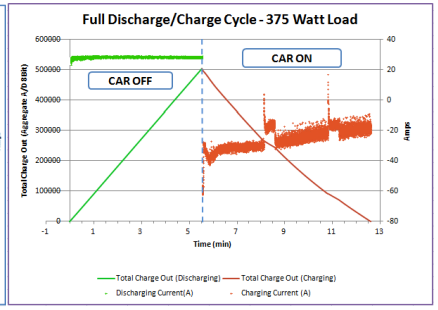
The design of the project is split into two parts: power distribution, and control system. Safe and efficient power distribution is accomplished using properly rated fuses, power connectors, and wire gauges to deliver the DC current and voltage being supplied by the battery and alternator to the DC-to-AC inverter. This wiring is connected at a junction where both the battery' connection and alternator connection meet. A hall-effect sensor monitors the net current going into the battery. The control system comprised of a microcontroller device uses the knowledge of the current and the battery voltage to start and stop the car's engine as needed utilizing a solenoid to depress the mechanical button of a small wireless remote engine starter.



System Schematic







Car Off	80.12	min	90.0748	%	Car Off	5.5258	min	43.8796	%
Car On	8.82833	min	9.92524	%	Car On	7.0673	min	56.1204	%

Results

Graphs to the left give a profile of the system over engine start/stop cycles. The generator does not have to run constantly to provide a constant supply of energy to the attached loads. The car does not have to idle constantly to supply the test loads. The system becomes most efficient when the alternator output approaches its maximum, and the size of the load does not cause a large voltage drop across the internal resistance of the battery.

Future Work

- Incorporate a bank of batteries instead of a single battery.
- Attach the inverter closer to battery bank
- Improve system to work on a larger scale. (larger generator)

Acknowledgements

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