Second Generation Bicycle Recharging Station

UGRADS Capstone Presentation

J. Alhabshy, R. Alzahrani, B. Gabrelcik, R. Murphy, R. Villezcas

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Overview

- **Project Definition**
- **Final Design**
  - Alternator and Mounting System
  - Electrical System (Capacitor and Inverter)
  - Display System (Outlets and Meters)
- **Testing Results**
  - Speed Requirements
  - Phone Battery Charge Rates
  - AC Inverter Efficiency
- **Video Preview**
- **Project Conclusion**
- **Real Life Application**

First Generation

- Used Lead-Acid batteries to store excess energy and stabilize current coming from the DC motor.
- Only provided DC power to specifically built in phone chargers.
- Possessed no gears to change the required riding speeds
- Was not designed with mobility in mind

Project Goal

- Goal: Design and improve a version of the first generation bicycle recharging station

Project Objectives

Objective	Measurement	Units
Powers Small Electronics	Test with a Load Bank	Watts
Durable Display	Surface Roughness/Scratches	Number of Scratches
Reliable Design	Maintenance Costs	Dollars
Efficient Storage System	Test System Load Capacity	Watts
Inexpensive	Cost of Additional Components	Dollars
Aesthetically Pleasing	Compare Survey Results	Survey

Constraints

- Capable of charging common electronic devices in only a few hours
- Charging station must be capable of being converted from stationary to mobile in only a few minutes

Final Design

- **Alternator Mounting System**
  - Alternator
  - Mounting System
  - Mobility Feature
- **Electrical System**
  - Capacitor
  - Inverter
  - DC Converter
- **Display System**
  - AC and DC Outlets
  - Voltage and Current Displays

Design Summary - Alternator

- A single-wire, self-exciting alternator was used
- No initial charge required to start up
- Contains an internal voltage regulator
- Capable of producing large amounts of power

Design Summary - Mounting System

- Built from a stationary bike stand
- Allows the alternator to be easily disengaged
- Can attach to bike above the rear tire to allow mobility

Design Summary – Electrical System

- Converts alternator power to usable DC and AC current
- Designed to handle up to 300 Watts
- Open terminals to allow external loads to be added if desired

Design Summary - Capacitor

- Purpose is to stabilize the fluctuating current coming from the alternator
- Designed to be used in automotive stereo systems
- Can handle up to 1000 Watts of power (more than three times our maximum output)

Design Summary - Inverter

- Purpose is to convert DC voltage into usable AC power supply
- Capable of supplying up to 300 watts of power
- Built in DC/DC converter that provides power universal USB plugs

Design Summary – Display System

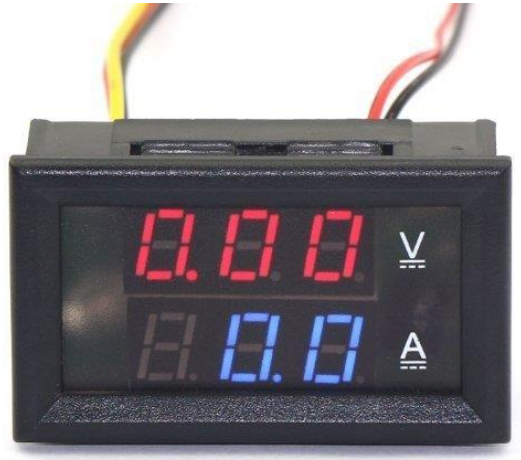
- Houses commonly used outlets to easily provide AC and DC power for the rider

- Measures and displays the voltage and current for both the DC and AC power supply

Design Summary – Display Meters

- DC display uses a shunt device to measure the amps going to the DC output

- Both meters display real time measurements to help the rider understand the power they're producing

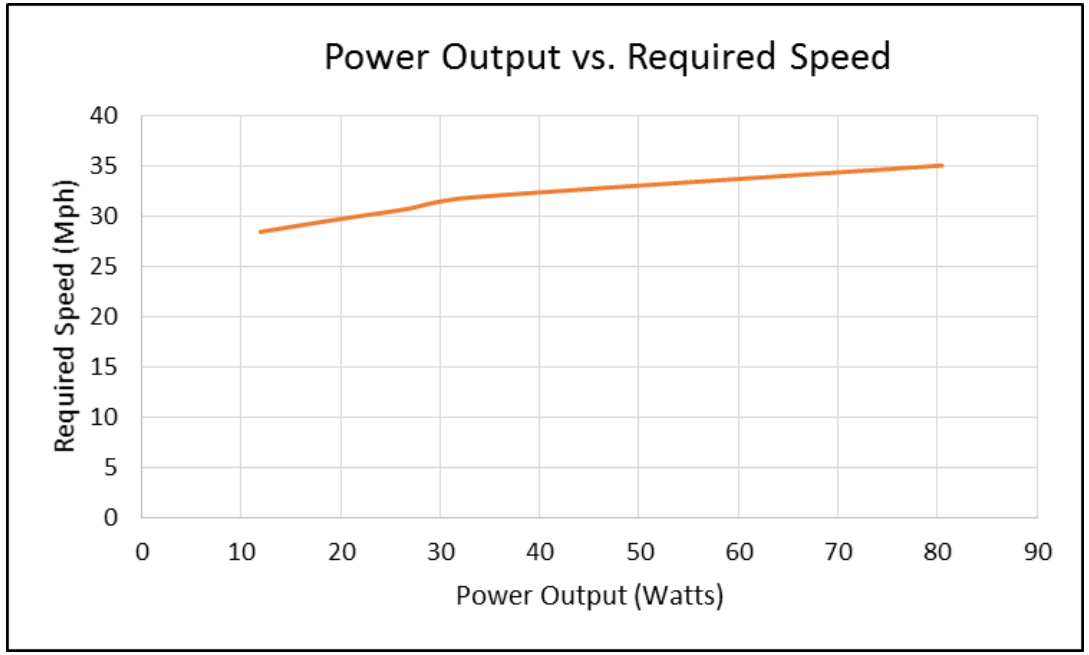


Testing Results

- **Speed Requirements**
  - Speed required at various power outputs
- **Battery Charge Rates**
  - Amount of battery charged in a single hour
- **AC Inverter Efficiency**
  - Overall efficiency as power output is increased

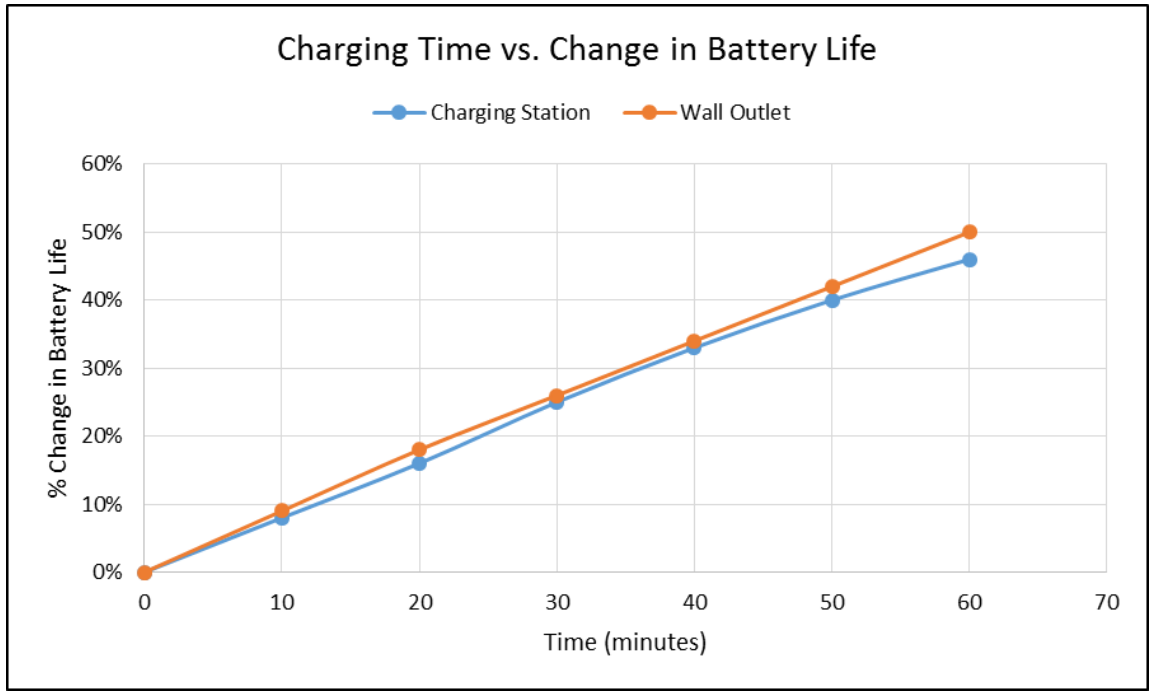
Testing Results – Speed Requirements

- Increase in required speed is relatively low as power output increases
- Speeds were not too high for normal operations
- Gears can be changed to allow easier use of the station



Testing Results – Battery Charge Rate

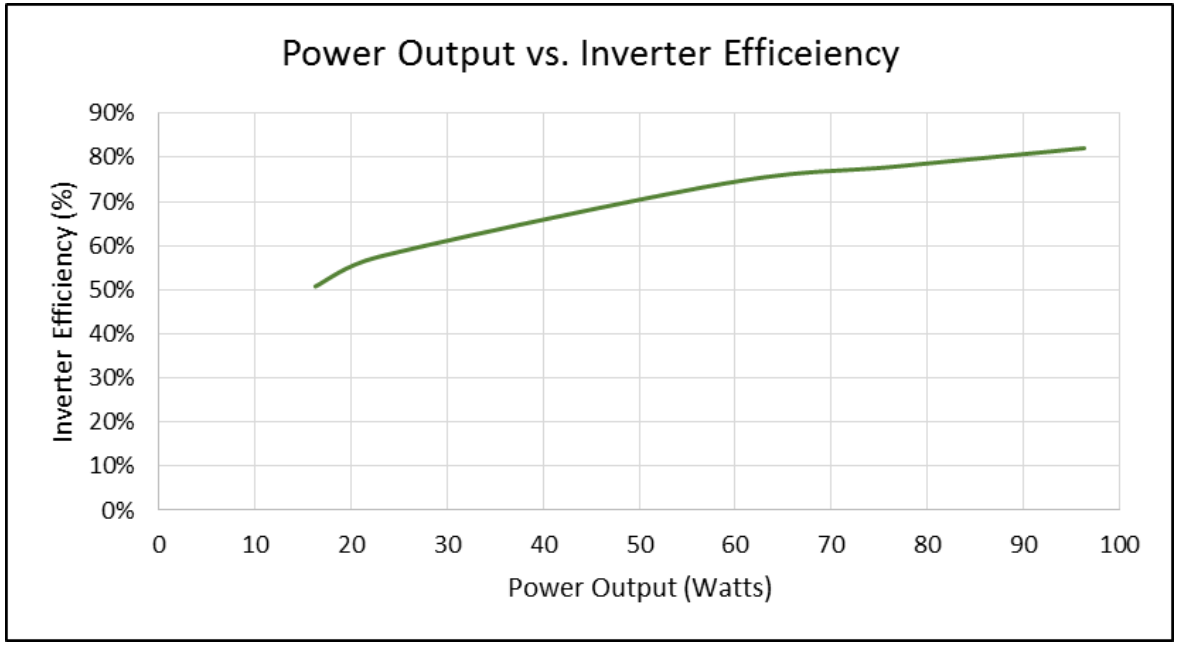
- Increase in Battery Charge consistent for both the bike and an average wall outlet
- Increase of 46% after one hour of charging on the station
- Estimated time to charge a phone was around 125 minutes



Testing Results – AC Inverter Efficiency

- Efficiency approximately 80% when the power output is greater than 90 watts

- Inefficient when the load is lower than 90 watts



Video of Project in Action

https://www.youtube.com/watch?v=SC1QdhcDu6Y (for online viewers)

Project Conclusion

- The charging station is capable of powering multiple electronic devices at once
- The station can provide up to 300 watts of AC power to the rider
- The design can be mobile by simply detaching the alternator and rotating the mounting system
- The entire system increases efficiency from the previous design by utilizing a large capacitor instead of lead-acid batteries

Applied in Real Life

- Can be used in third world countries to provide clean renewable energy
- Promotes a healthy lifestyle while teaching about the benefits of renewable energy
- Is a relatively simple design that can be replicated with ease

References

[1] Bird, John (2010). Electrical and Electronic Principles and Technology. Routledge. Pp. 63-76 ISBN 9780080890562. Retrieved 2014-10-17.

[2] “440 Watt Regulated Pedal Power Bicycle Generator” bdwhaley. Available: *http://www.instructables.com/id/Bicyle-Power-for-Your-Television,-Laptop,-or-Cell-/*

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Questions