

## INTRODUCTION

### The Problem



- Although fun to ride, conventional bicycles are slow.

### The Market's Solution



- \$2200
- 30 mile range @ 34 mph
- no regenerative braking

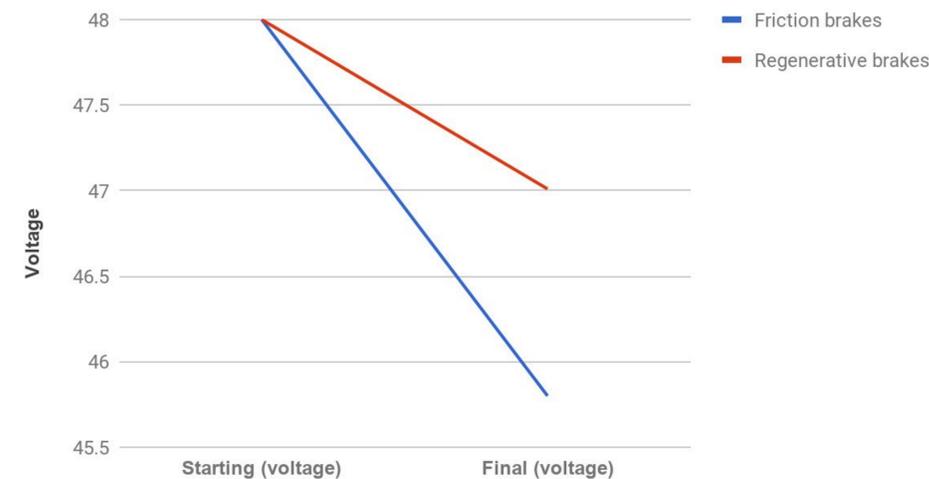
### My Solution



- \$650
- 30 mile range @ 32 mph
- regenerative braking for increased range

## DATA AND FINDINGS

### Friction Brakes vs. Regenerative Brakes



2.64% of the bike's battery life was retained as a result of using regenerative brakes in place of friction brakes.

## CONCLUSIONS

Over the course of this project, I learned how to build an e-bike to my exact specifications and saved \$1,550.

- Although the regenerative brakes did not return as much energy to the battery as expected (2.64%), for people commuting long distances, or up and down hills, this homemade regeneration system could make a much bigger difference.
- I also learned the importance of insulating live wires through direct experience. With the controller connected to the battery, I accidentally shorted two wires on the controller that blew an internal fuse.
- Moreover, this project gave me invaluable experience: the art of changing many flat tires, adjusting a derailleur, and maintaining brake pads and cables as well as stripping wires, checking connections, and securely mounting a massive battery onto my frame.

## BACKGROUND

### RESEARCH QUESTION

I researched the efficiency gains of a DIY regenerative braking system. Using a set bike course, I measured the battery voltage both before and after the course first using friction brakes and then regenerative brakes.

### HOW IT WORKS

- The operator twists a throttle which draws power from the battery.
- Power is sent through the speed controller to the hub motor in the rear wheel to propel the rider forward.
- For regenerative braking, the operator uses a braking throttle that sends a signal to a quadrant IV controller with the ability to switch the motor polarity, effectively turning the motor into a generator, which gives energy back to the battery for future use.

## METHODOLOGIES

- Start with a used mountain bike and remove the rear wheel in order to attach a new wheel with a hub motor
- Solder connections for the battery and electronic speed controller and connect to the motor to the speed controller.
- Attach a twist grip throttle and mount the battery and securely mount the speed controller on the frame.
- Attach a twist grip throttle on the left handle and solder it to the reversed function on the speed controller allowing for the motor to reverse its direction when this throttle is in use.
- Consolidate wires into one bunch for safer high speed travel.

## ACKNOWLEDGEMENTS / REFERENCES

Special thanks to my mentor, Mike Camicia, and to Javid Alasti and Donald Olgado for their brainstorming and technical assistance.

### Works Cited

- Bolton, B. (n.d.). Electric bicycle regenerative braking. Retrieved October 29, 2017, from Electric bike solutions LLC website:
- Electrical theory and practice tests. (n.d.). Retrieved October 29, 2017
- Lampton, Christopher. "How regenerative Braking Works." HowStuffWorks, HowStuffWorks, 23 Jan. 2009
- Lampton, C. (n.d.). How regenerative braking works. Retrieved October 29, 2017
- Linder, C of Reliance Electric | Jun 01, 2000. "Regeneration with Adjustable Frequency Drives." Machine Design, 1 Apr. 2013
- Santoni, T. (2009, February 10). Understanding regeneration. Retrieved October 29, 2017