Battery Charging Bicycle Attachment

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Abstract

Working adults are turning to bicycles as an environmentally friendly and convenient way to travel as gas prices and population density in cities increase. Portable electronics such as cell phones and wireless headphones have skyrocketed in popularity over the past decade. The introduction of powerful cameras, powerful processors, HD screens, and HD speakers on a portable scale has caused people to become increasingly dependent on smartphones in particular. Battery technology has failed to improve at the same impressive rate. Since bicycle riders are not immune to the issue of dead electronics, the purpose of this project is to use a bicycle to create an affordable method of charging portable electronics all the while preserving a comfortable riding experience for the cyclist. The user will have the choice of safely charging Universal Serial Bus (USB) devices or a 9.6 volt nickel metal hydride (NiMH) battery so the user can continue to charge their devices away from the bicycle.

Mechanical System

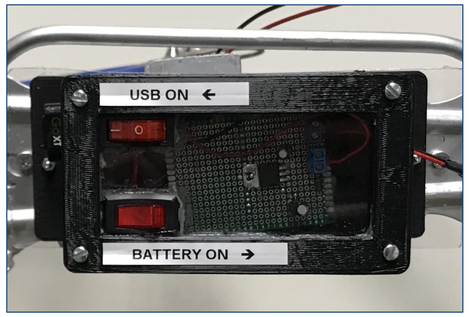
The system translates rotational motion from the wheel to a generator through the use of a chain. This system was inspired by standard car alternator. A 6 inch diameter sprocket is fastened to the spokes, while a 2 inch diameter sprocket is connected to the generator using high strength steel based epoxy. A 415H motorcycle chain is used to translate rotational motion between the two sprockets.

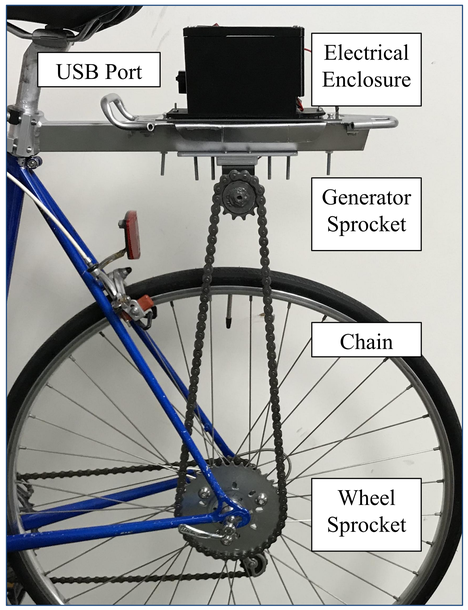
The generator itself is a 24 volt, 200 rpm motor. When power is applied to a motor a resulting torque is created. When torque is applied to the motor shaft, power is generated in the form of electrical energy. The electrical power is then used to charge a 9.6V NiMH battery or USB devices. The 3:1 ratio between the sprockets allows for sufficient power generation without inhibiting the rider’s experience.

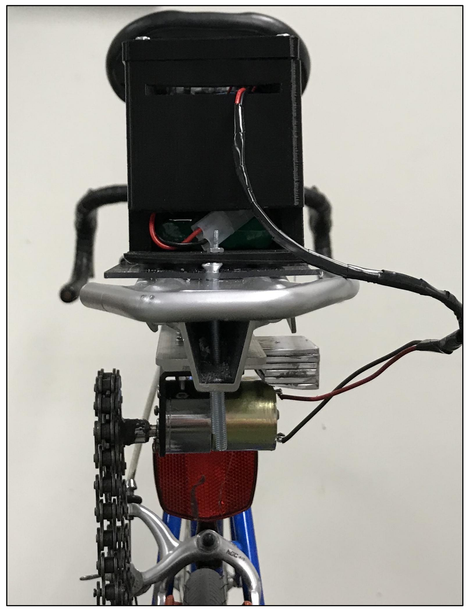
The electrical circuit is housed in an ABS plastic enclosure designed to protect the system from moisture while providing necessary air flow. The housing is fixed to the bicycle using a standard bike rack. The rack is capable of supporting 38.85Nm, which is sufficient for the forces that are applied by the chain and housing. Ultimately the system is durable and capable of withstanding regular road usage.

Design

The goal of this design is to give the cyclist the ability to choose between charging a removable battery or a USB device. The removable battery provides the user with the ability to charge devices when they are no longer riding the bicycle. This design allows for the system to be used across multiple bicycles all the while limiting any intrusions on the rider’s pedalling experience. Lastly, the designs aesthetically pleasing features are an added bonus that will increase the user’s likelihood to use the product.



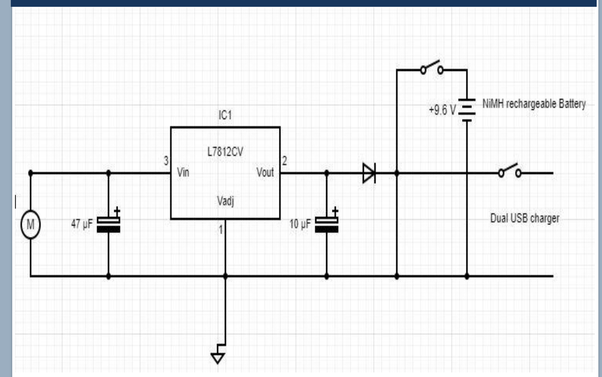




Future Development

The system was successful in charging both USB compatible devices and a 9.6V NiMH portable battery. However, the charging times of 4.5 hours for a typical phone limits this success. In its current state, the system can only serve supplement to regular charging, rather than a substitution. Another goal for the project was to design an affordable system. T he final price of $102.73 fails to do this. Thankfully, 90% of this cost comes from outsourced metal parts so this can easily be reduced by machining the parts internally. If there is any interest in marketing the Battery Charging Bicycle Attachment to cyclists as a environmentally friendly method of charging your devices, the cost and charging times must be reduced.

Electrical Circuit



The Electrical system uses a voltage step down circuit which consists of a 3 pin voltage regulator (L7812CV) and two capacitors (47uF and 10uF). The regulator steps down a varying voltage input as high as 32V to a constant output voltage of 12V. Capacitors are used to reduce noise from input voltage to create a smooth output voltage. A1N4002 diode was used to prevent of backflow of current that would lead to battery discharge and increased pedaling resistance. Depending on the switch orientation, the circuit either charges the 9.6V battery directly or is stepped down once again to 5V to charge a USB device.

Results and Conclusion

Overall, the project was a success. The system was able to charge a USB device and portable battery as promised. Although the design can charge faster than a computer USB port, the resulting charging rates prove that the Battery Charging Bicycle Attachment cannot serve as substitute for a standard outlet.

	iPhone X	NiMH 9.6V Battery
Capacity (mAh)	2658	2200
Input Voltage (V)	5	12.1
Input Current (A)	0.6	0.6
Input Power (W)	1.8	4.4
Charging time (h)	4h 25m	3h 40m

Acknowledgments

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