Feasibility of a Wind Energy Generation Device for Personalized Vehicles

Clarissa Halpern

College Park Scholars – Science & Global Change Program

Biology: Cell Biology and Genetics

chalpern@umd.edu

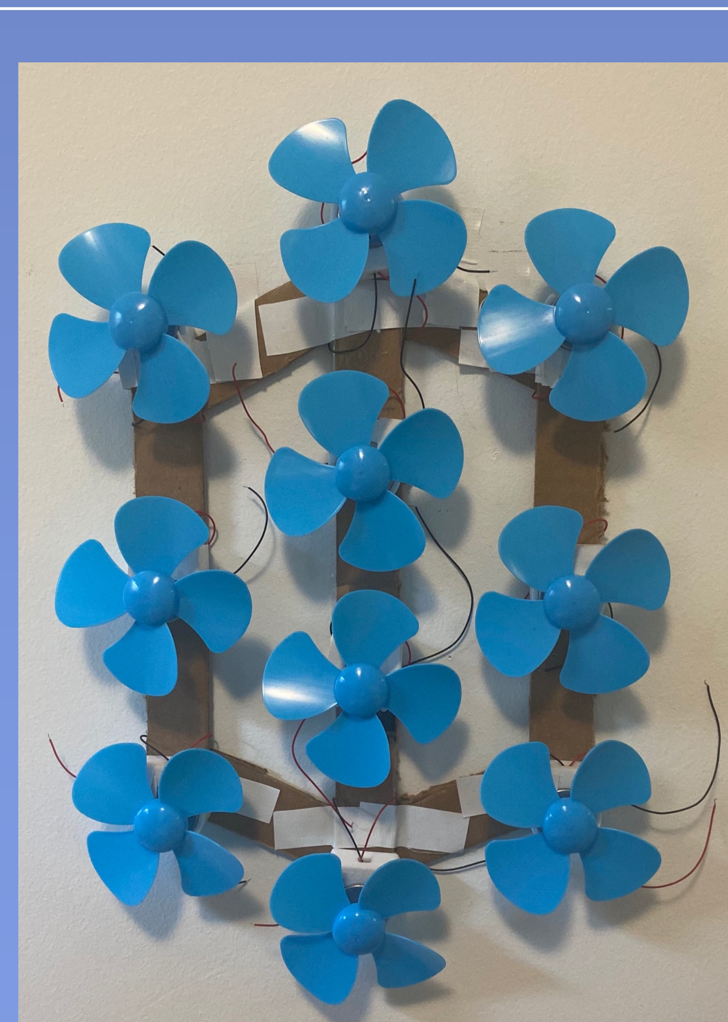
College Park Scholars Academic Showcase, April 30, 2021

Introduction

There is a rising need for alternative energy sources as climate change continues to pose a threat to global society. Wind energy created by turbines is not consistently available, but I believe that wind energy can be harvested more readily than believed. I created this device for personalized vehicles like electric scooters because there are areas of a personalized vehicle that are underutilized.

My Product:

I designed, tested, and constructed a device featuring an array of ten turbines that turn with a vehicle's forward motion, producing power to help charge the vehicle. In this case, it can be placed on the front of a scooter, and wiring can run from the array to the battery charging the scooter below the foot deck.



Left: My dad came to campus to help me conduct trials. I stuck a turbine out the sunroof of the car and measured the voltage output as my dad drove the car at different speeds.

Right: My prototype design with ten fans arranged in an array. The fans, motors, and wires were purchased through Amazon.

Site Information:

Supervisor: Dr. Romel Del Rosario Gomez (rdgomez@umd.edu)

Goals: We met over Zoom to discuss ideas, electrical design, circuits, energy conversion, batteries, and progress in research and construction. We also met in person a couple of times to exchange materials for the final prototype. This project is engineering-focused which is out of my academic comfort zone. However, this project is something I dreamed of for a while now, so I was determined to complete it.

Issues Confronting Site: My project addressed the need for more alternative carbon-neutral energy sources. The idea and design help to reduce the number of times a vehicle, in my case an electric scooter, needs to be refueled or recharged, thus reducing carbon emissions.

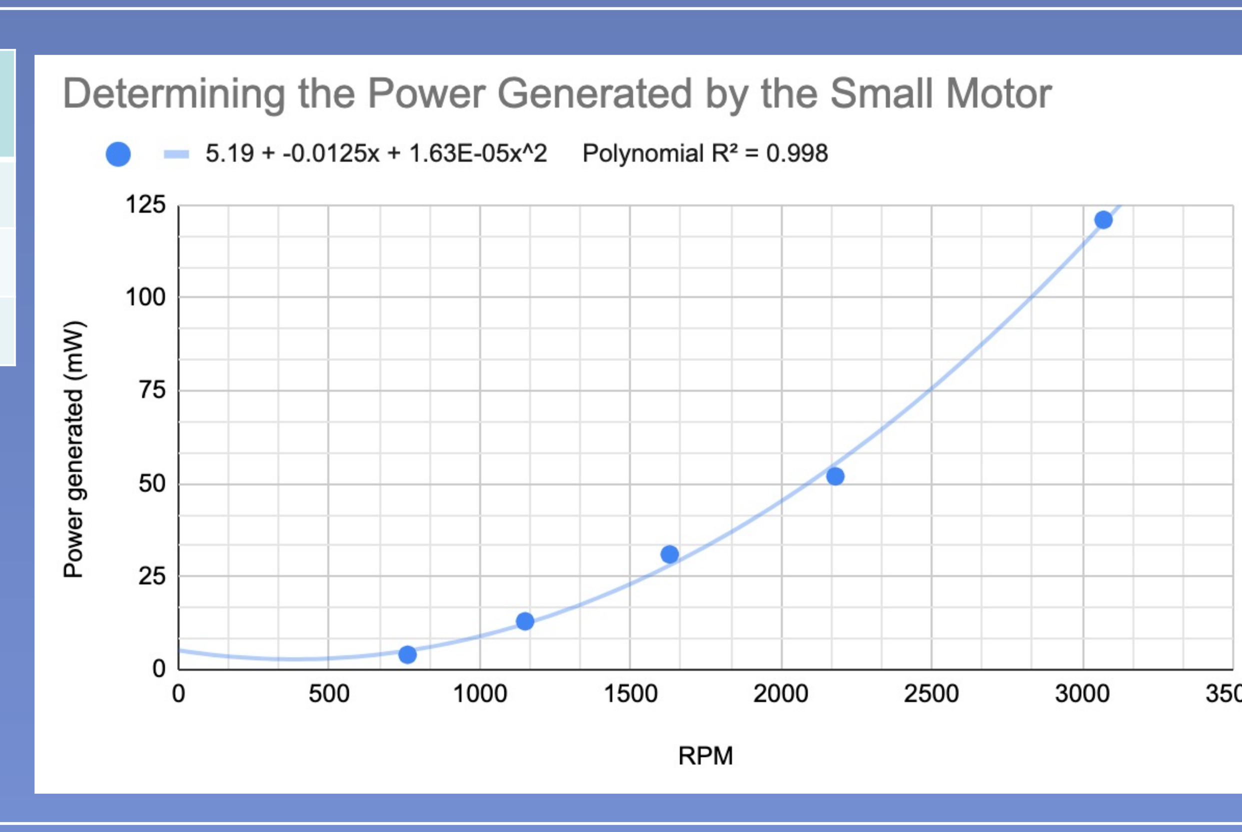
Results:

With moderate wind at about 1,550 RPM, an average voltage produced by a single fan at any given moment with a 10 Ohm resistor is 0.50 volts, which is 25 mW of power. Therefore, my array of ten fans produces 250 mW of power. Since a scooter travels about 15 miles per hour, my array design produces about 500 mW at any given moment.

Speed (mph)	Voltage output	Current (mA)	Power (mW)	Motor RPM
10	0.75	75	56.25	~900
15	1.50	150	225	~1800
20	1.80	180	324	2180

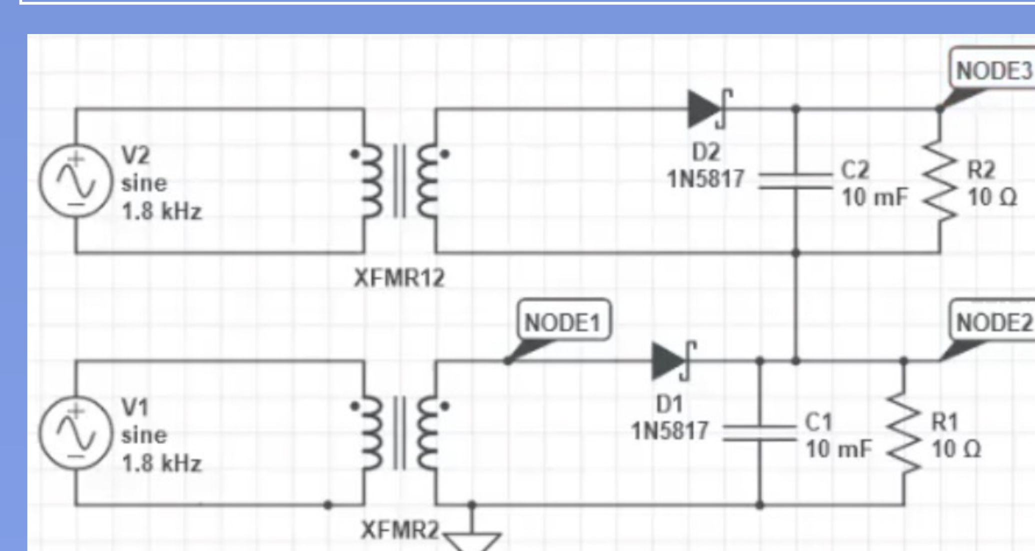
Above: The table shows data from when my dad drove the car at certain speeds. I calculated the current and power from the voltage output. Dr. Gomez tested my motor by attaching it to an oscilloscope to determine the RPM.

Right: I graphed power output versus motor RPM to determine the power of my motor.



Findings:

A scooter's forward movement creates wind from the perspective of the vehicle, which subsequently turns the blades of the fans in the array of turbines. The mechanical energy is converted into electrical energy, powering the vehicle. This additional power decreases the number of times an electric scooter needs to be charged as it increases the amount of time between charges. This ultimately helps the planet, since fewer carbon emissions would be emitted with fewer electrical charges.

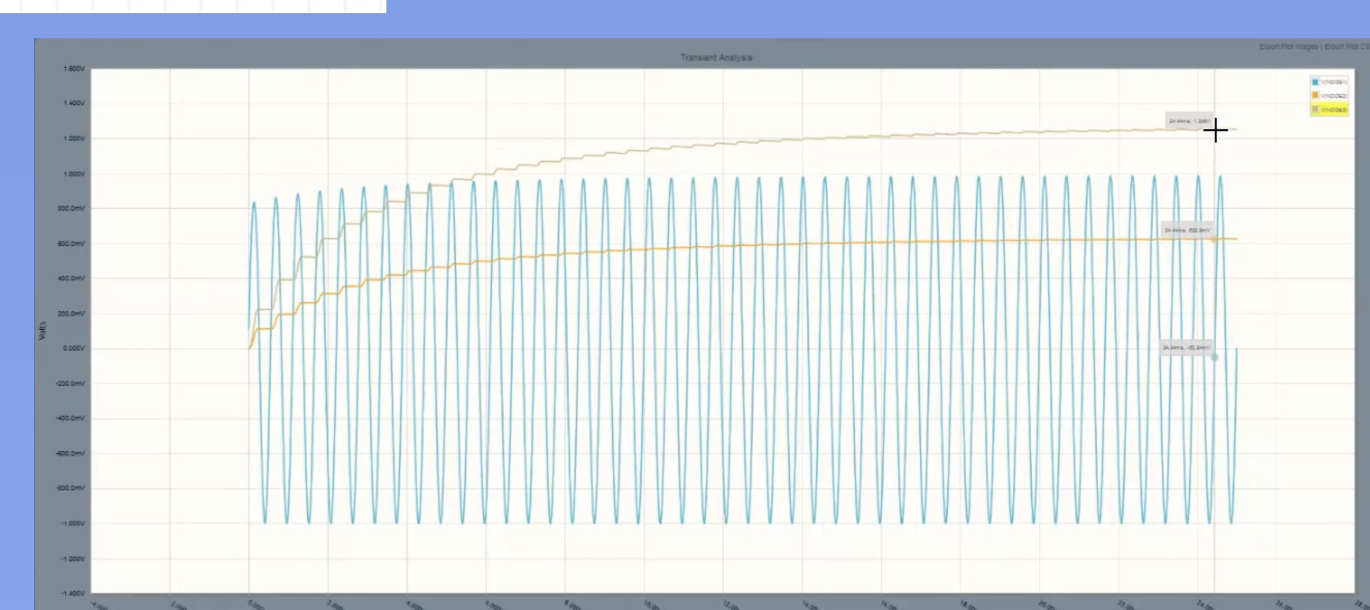


Circuit Design:

Left: My prototype generates alternating current, but direct current is needed to produce power. I used circuitlab.com to simulate my array. The circuit on the left shows two turbines with a Schottky diode to maintain 70% of the current and a capacitor to rectify the current.

Circuit Design:

Right: The resulting graph from the above circuit is shown, depicting voltage versus time. This graph demonstrates that the negative voltage from the Alternating Current is successfully rectified to provide Direct Current.



Acknowledgments:

Thank you so much to Dr. Thomas Holtz and Dr. John Merck for the most engaging and informative two years in the Science and Global Change Program in College Park Scholars. I would also like to thank Dr. Romel Gomez for your enthusiastic support to nurture this idea into a reality.

Discussion:

Dr. Gomez and I had to meet over Zoom, which had its difficulties. We could not work on construction together or draw out potential circuits in-person, but we still made it work with the technology provided by Zoom.

With the motors and materials used, my array does produce power, but certainly not enough to power the scooter. For example, a phone battery has a capacity of 2,800 mA-hr and requires 3.7 volts, so it would take 20.72 hours to fill the capacity with my array of ten turbines (3.7 V * 2,800 mA-hr / 500 mA = 20.72 hr). Better motors are heavier and more expensive, but they can allow for more power to be produced.

This device can be applied to larger vehicles, such as cars, buses, or boats, since these vehicles can support heavier motors and can travel faster, producing more power. I hope that this will also further research into more sustainable engineering for areas of larger vehicles that are underutilized.

SCIENCE AND GLOBAL CHANGE