

Small Scale Wind Turbine - Swift Dynamics

By Benjamin Janey, Marcus Alexander Rodriguez, David Lima, Collin Kramer, Jimmy Scoggan, and Zachary Klienberg, in collaboration with Mahmoud Abdelgali

Executive Summary

Objective: The primary objective of this project was to design a portable camping wind turbine that can generate enough energy to charge devices for a family overnight.

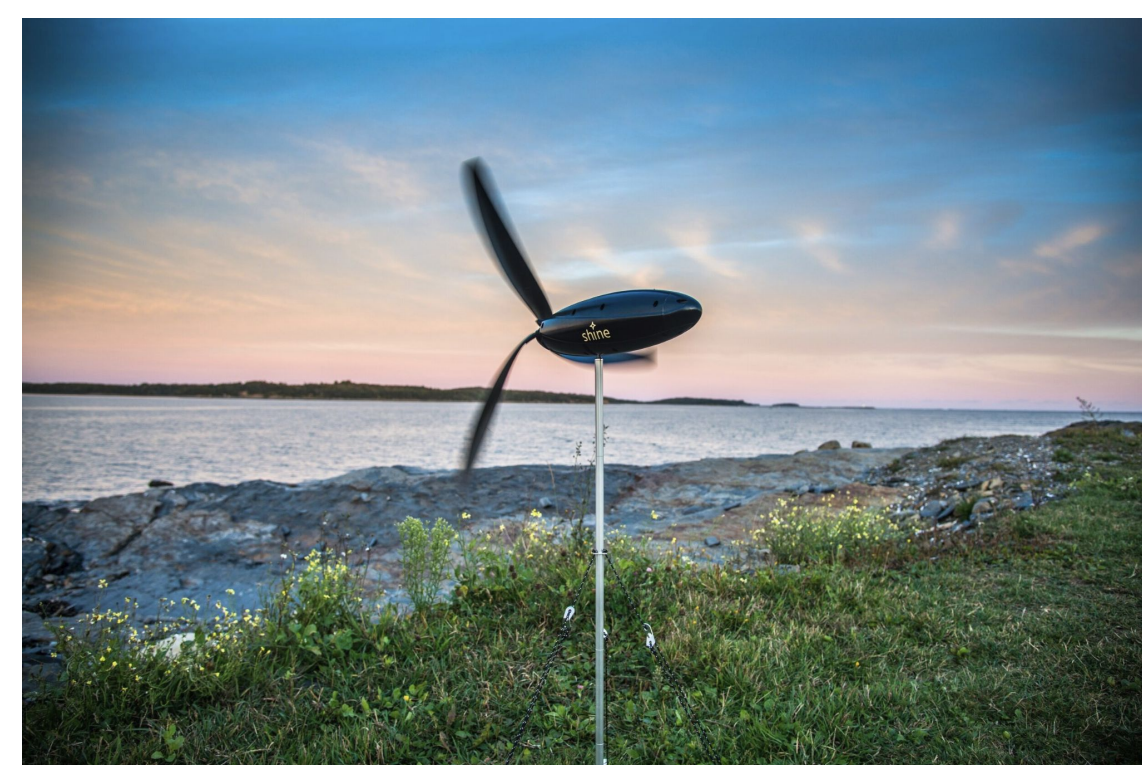
Challenges: Some key challenges related to this problem are as follows: designing a light-weight and portable turbine mechanism that can be set up by one individual, designing a turbine that can generate the necessary energy to power devices, and keeping the product in an affordable market position.

Solution: The Swift Dynamics Wind Turbine features a detachable 17"x20" swept area vertical axis wind turbine that can handle turbulent winds and low wind speeds. The whole unit weighs roughly 7.8lbs and each individual component is less than 10" in length.

Existing Solutions

Shine Turbine

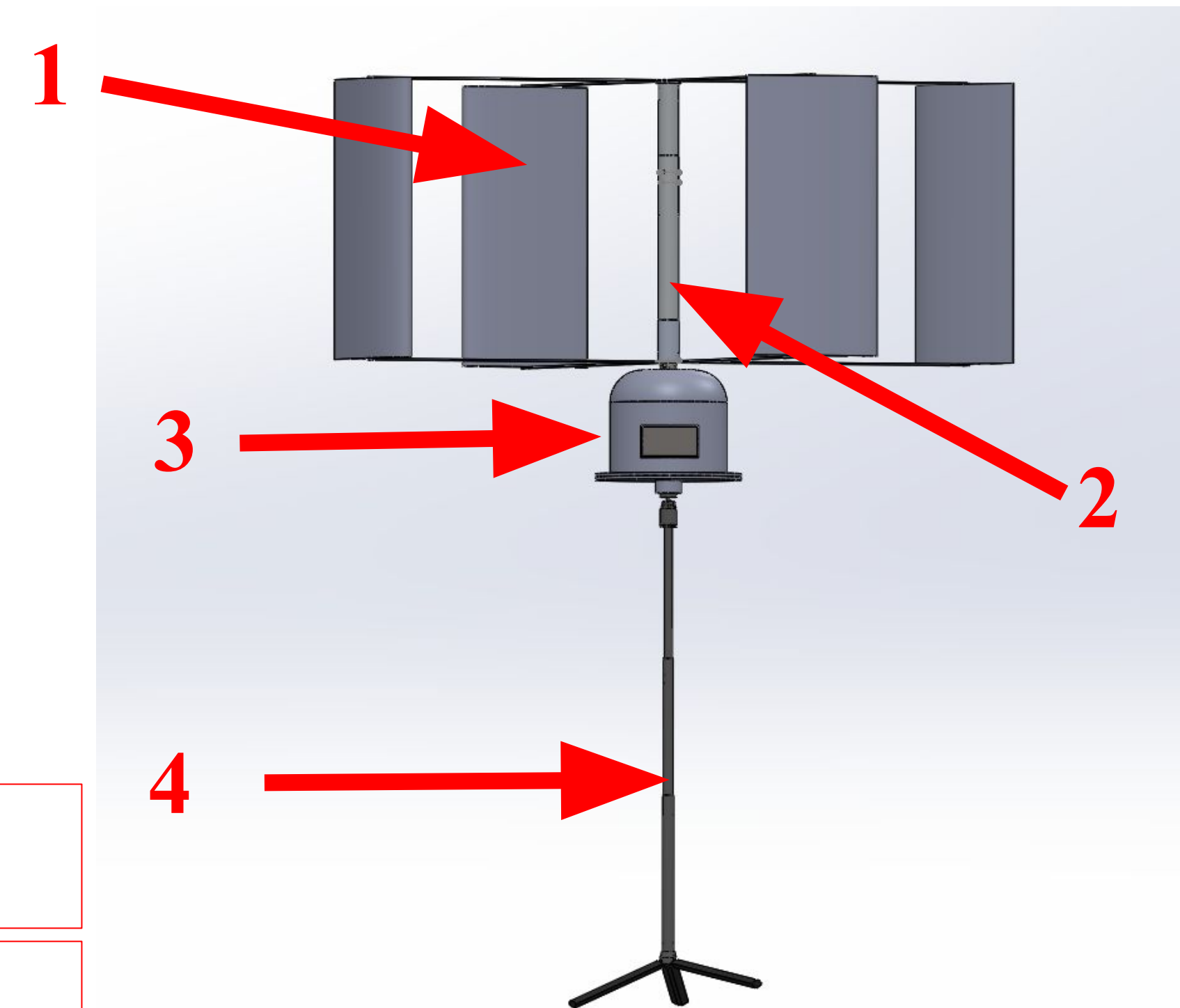
- ~\$550 retail price
- Horizontal axis wind turbine
- 3lb weight and "water-bottle" footprint
- Generates 40W at high wind speeds



Shine Turbine: Design has high minimum startup speed of 8mph and has low energy generation at slower speeds.



Swift Dynamics VAWT Concept



- 1) Turbine blades: Can split in two and features locking mechanisms
- 2) Telescoping rotor shaft which collapses down to <8.5"
- 3) Electronic housing with integrated power output LCD
- 4) Telescoping tripod stand which collapses down to 12"

Features

- Fast charge compatible, removable 10,400 mah power bank
- 12W of power generation at wind speeds of 16mph
- Startup speeds of arond 5-6mph
- Retractable rotor shafts, with lock-in turbine blades
- Weighs under 10 lbs and can fit within a 36L camping backpack
- Environmentally friendly form of energy generation

Analysis

Energy Charge Analysis

- Product can generate up to 60W of energy
- Works in turbulent, multi-directional, near-ground wind
- At 12W (16mph) of generation, can charge 5 devices below from 0% capacity to full within 8 hours
- At 5W (11mph) of generation, can charge devices from 50% to full within 8 hours.

Device	Voltage (V)	Capacity (mAh)	Capacity (Wh)
iPhone 14 Pro	3.8	3279	12.4602
iPhone 14 Pro Max	3.8	4323	16.4274
Generic Flashlight	3.8	2000	7.6
Camera Battery	7.4	2500	18.5
Battery Pack	3.8	10000	38
TOTAL	22.6	22102	92.9876

Performance

When tested at 2000RPM, generator outputs DC signal of ~12V ~5A, equivalent to 60W.

This is enough energy generation to charge all five devices from 0% to full within 1.5 hours.

Future Improvements

- Decrease product footprint and weight
- Introduce a folding airfoil utilizing nylon fabric and solid aluminum structural rings
- Increase battery storage capacity
- Optimize mechanical losses introduced by planetary gear increaser
- Optimize turbine swept area to best weight:energy ratio

Safety

- Implement IP67 waterproofing
- Implement braking system for consumer safety and electrical safety om the future.
- All parts used including electrical boards, batteries, motors, and stand satisfy applicable ISO, RoHS, and UL standards.