Hydropower Turbine

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Project Description

The hydropower turbine design is geared towards outdoor enthusiasts who wish to have a source of electricity in remote places. The hydropower turbine system will have the ability to generate electrical power from the flow of a stream or river. The turbine will satisfy a series of functional requirements (listed below in the objectives section) that aim to produce safe, convenient and reliable power without detracting from the outdoor experience. Furthermore, the turbine will have minimal impact to the surrounding environment while producing either 120V AC or 12V DC depending on the users need. Instructions will be generated regarding the use and minimum flow requirements necessary to properly power the turbine.

Engineering Standards

European Small Hydropower Association

- Provides a guide on evaluating streamflow and electromechanical system design principles

NEMA MG 2-2014

- Definition of waterproof machine
- Corrosion protection
- High potential testing
- Overspeed

NEMA 250-2003

- Electrical enclosure types

ANSI Z535

- Design and application of safety symbols, signs, and colors

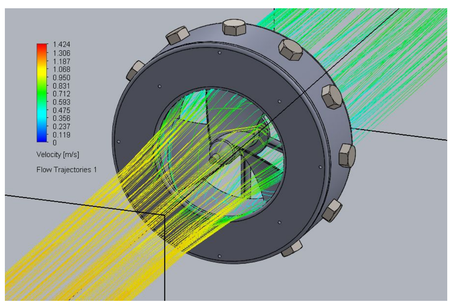
Consumer Product And Safety Commission

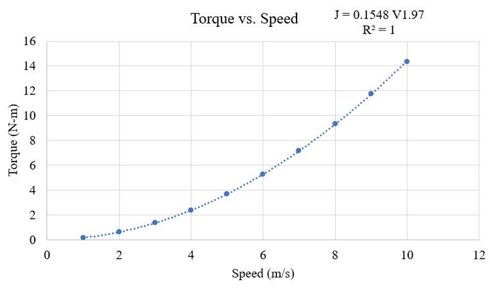
- Technical specs relating to performance and safety of device

Data

SolidWorks Flow Simulation

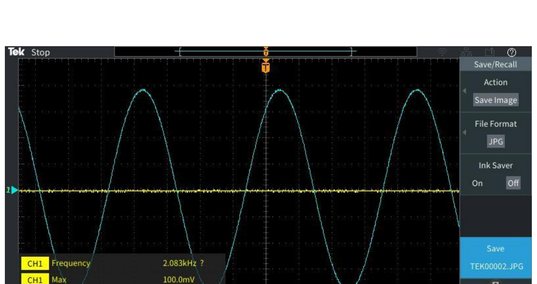
- Flow simulation of the turbine design from 1-10 m/s streamflow
- Used to simulate the dynamics of the turbine
- Outputs an estimation of turbine torque
- Used as an input for a mathematical model of the system

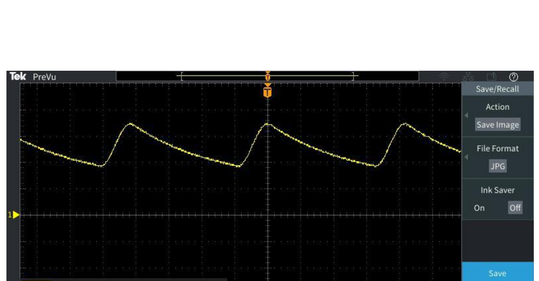




Prototype Circuit Testing

- Circuit testing shows that it rectifies
- But input voltage not high enough for voltage regulator to work
- So slight ripple in output waveform
- When desired input voltage is used circuit should rectify and produce desired voltage
- The graphs below show the input on the left and the output on the right from the circuit test
- Graphs measure voltage vs time





Functional Requirements

- Portable/Compact
- Reliable
- Durable
- Ease of use
- Charges other high voltage power sources
- Usable By Low Voltage DC Devices
- Scalable
- Low Impact On Environment

Product Specifications

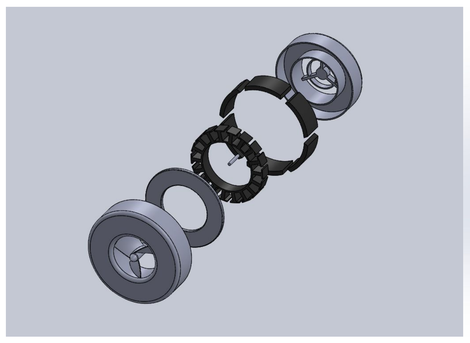
- 1.5x1.5x.15
- 8lbs
- Run for 100 hours
- Setup in 5 minutes or less
- Outputs 12V DC
- Maximum speed: 14m/s (600RPM)
- Can charge deep cycle batteries

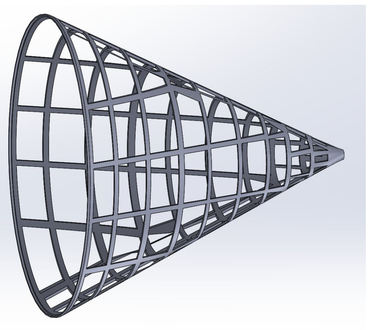
Project Justification

A hydropower turbine is more desirable over alternatives such as solar or wind power because the sources of energy for these two examples are inconsistent. To harness wind energy requires sufficient wind consistently. Wind also changes directions randomly and can be difficult to harness the energy when the direction keeps changing. Solar is not effective because it requires sunlight, which means it cannot harness energy at night or on a cloudy day. While the hydropower turbine design can be difficult to find a source of hydropower such as a river or stream, it proves more reliable because it can be operated anytime day or night, rain or shine, and the water consistently flows in the same direction. This meets the needs of outdoor enthusiasts that need a reliable source of power while on the trial or out by the river.

Design

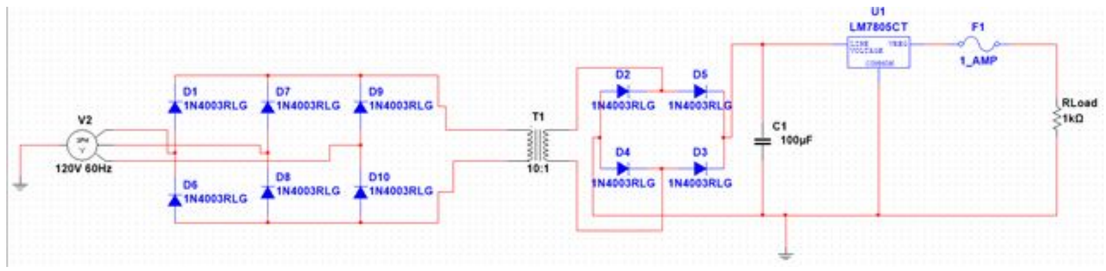
- 3-phase brushless AC motor
- Propeller blade
- Environment protection netting





- Alpha Prototype

- Conversion circuit designed to rectify AC voltage to 12V DC



- Prototype circuit