DEPARTMENT OF MECHANICAL ENGINEERING

TEAM C4
Portable Water Desalination Device

Mickyas Abebe, Harjas Aneja, Blake Pahlavan, Jack Pitsley, Jeremy Tao, Mike Wang

A. JAMES CLARK SCHOOL OF ENGINEERING

Motivation, Goal, Impact

Objective: Design a portable, affordable, and sustainable device that can filter brackish water into clean drinkable water in areas without access to the electrical grid. Through this device, we can make clean drinking water more accessible to people whose circumstances aren't as fortunate as ours.

A Worldwide Problem:
- 1 in 4 people (2.1 billion) lack access to safe drinking water
- 1.7 billion people lack basic hygiene services
- 3.4 billion people lack access to safely managed sanitation

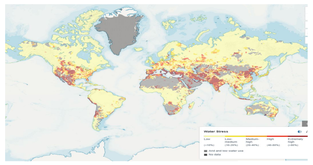


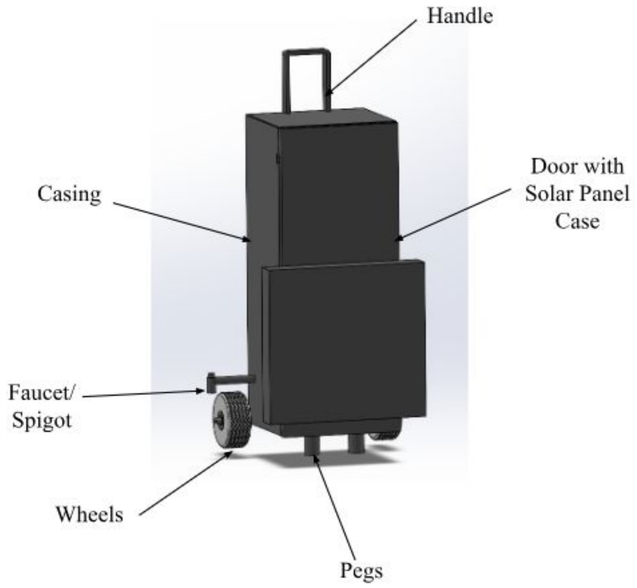
Figure 1: Water Stress Map; the red areas indicate places in which people have lower access to potable water

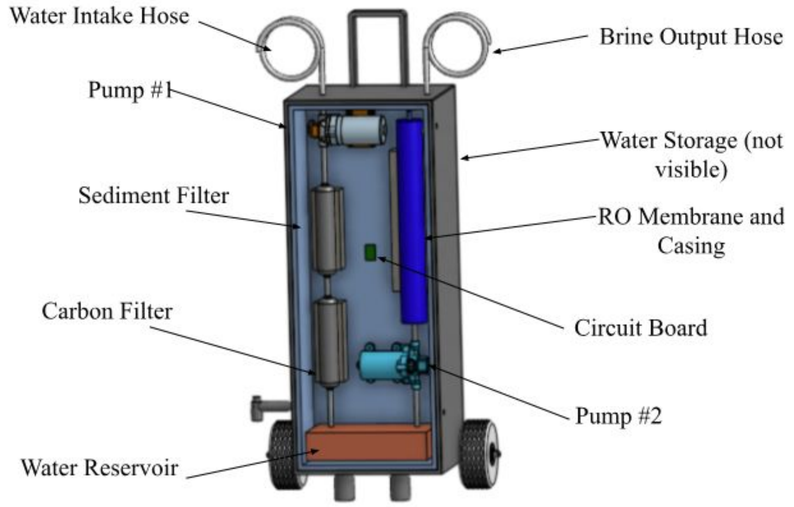
Stakeholder:
This project's main stakeholder lives in Uttar Pradesh, India. He lives in a village that often loses power and water at the same time. He currently lives near a brackish body of water, and his goal is to have a device that can create potable water for his family from this body of water.

Requirements

- **Produces Clean Drinking Water**
- **Disconnected From the Power Grid**
- **Powered by Sustainable Energy**
- **Portable Across Rough Terrain**
- **Easy to Maintain and Use**
- **Highly Durable**
- **Long Life Span**
- **Affordable to Developing Countries**

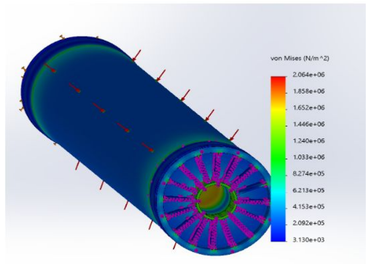
Final Design



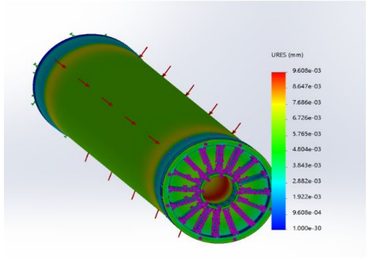


Design Calculations & Decisions

RO Membrane Selection
von Mises Stress

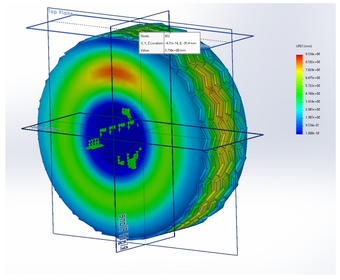


Displacement

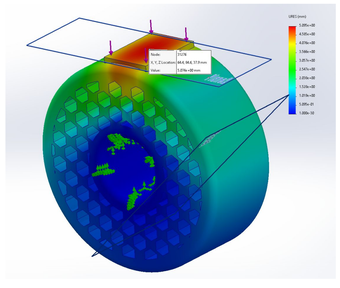


Decision-Making
- Optimized for sanity of 1000 ppm
- 8 gallons per day flow rate
- Must handle 120 PSI
- **Chosen**: SpiroPure 21" Membrane and Pentek housing system.

Wheel Design and Sizing
Pneumatic Design + Medium TPU

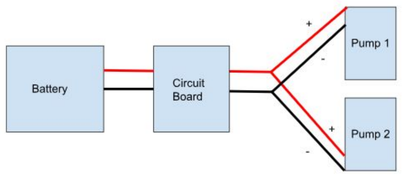


Hex Design + Soft TPU



Decision-Making
- Must handle ~50 lbs each
- Traverse rough and muddy terrain
- Have sustainable materials
- **Chosen**: Pneumatic Tire + Medium-strength TPU design

Battery Selection
Connection Diagram



Solar Panel Energy Output

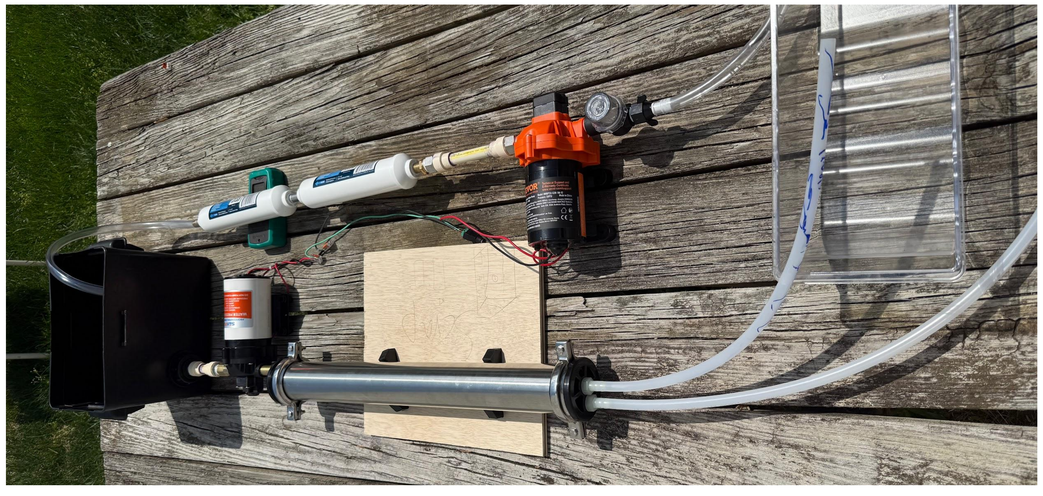
"Forward" task

You have your solar panel(s) -> You want to estimate the daily energy in kWh that it can produce

Enter **Pmax**, in **kWp** or **Wp**	150.00	Wp
Enter **PSH for your area, hours**	5	
Estimated **Solar panel output, Wh**	600	
Estimated **Solar panel Energy output, kWh**	0.6	

Decision-Making
- Must meet energy requirements for both pumps and handle energy storage for solar panels.
- Outputs 480 Watt-Hours to pumps
- DC, 12 V, 40+ Amp-Hours Capacity
- Portable and lightweight
- Withstand high temperatures and wet environments.
- Sustainable chemistry: must NOT be Lead-Acid chemistry
- **Chosen**: LiTime 12V 50Ah Lithium LiFePO4 RV Battery

Prototype & Test Results



Outside Casing and Wheels:
- Assembled full outside casing system with plywood to demonstrate the portability of the system
- 3D-printed the wheels and attached them to casing
- Tested the wheels on different terrains to determine the surface pressure they could handle (different for different terrains)
- Attached a handle to further enhance the prototype and do proper testing

Filtration System:
- Assembled full filtration system to demonstrate the functionality of the system
- Tested flow rate through system by changing the pressures in the pumps to determine the best performance of the system
- Tested water quality pre and post-filtration by using water test strips
- Tested for water leakage by observation
- Tested for amount of time it takes to get the end goal amount of clean filtered water (8 gallons)