Mohammad Mustafa Sajjad - Project Portfolio

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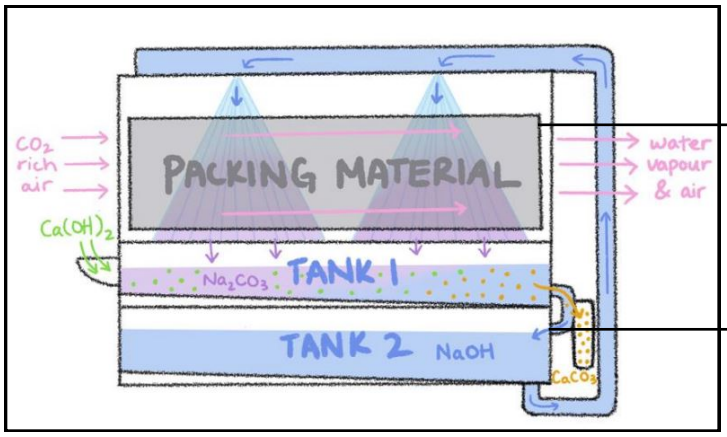
Carbon Capture (DAC) - Final Year Design Project

I was the lead for a final year design project, focused on developing a direct air capture system. The system used a wind tunnel along with chemical and electrical components to run two chemical reactions. It was able to capture carbon dioxide from the environment and store it in the form of calcium carbonate. After continuous testing, the final mass of carbon dioxide captured per cycle totaled **4.4 grams** for the proof of concept and **5.7 grams** for the final prototype.



Conceptual Schematic for the Direct Air Capture Unit

The 1st stage of the system used a wind tunnel stored with a dense packing material. The wind tunnel brought in ambient air containing carbon dioxide.

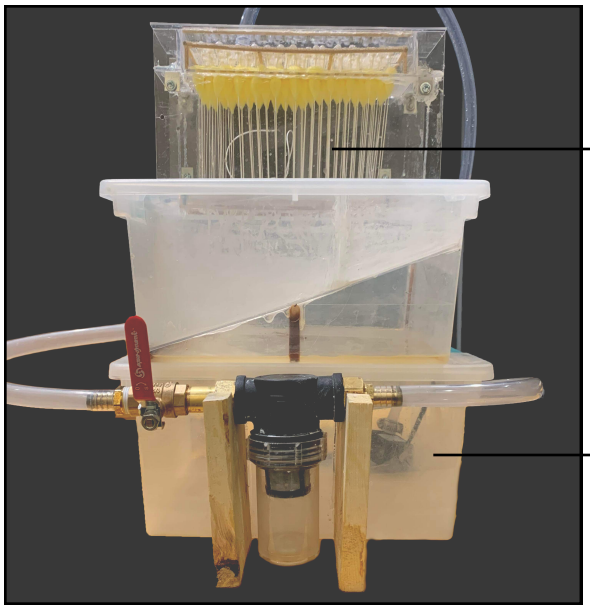
The 2nd stage of the system consisted of tanks 1 and 2 which stored the by-products of both reactions.

Reaction 1: $2NaOH_{(aq)} + CO2_{(g)} \rightarrow H2O_{(g)} + Na2CO3_{(aq)}$

Reaction 2: $Na2CO3_{(aq)} + Ca(OH)2_{(s)} \rightarrow 2NaOH_{(aq)} + CaCO3_{(s)}$

Chemical Reactions Driving the System

The calcium carbonate from reaction 2 was filtered out so that the sodium hydroxide by-product can be pumped back up to the top of the wind tunnel.



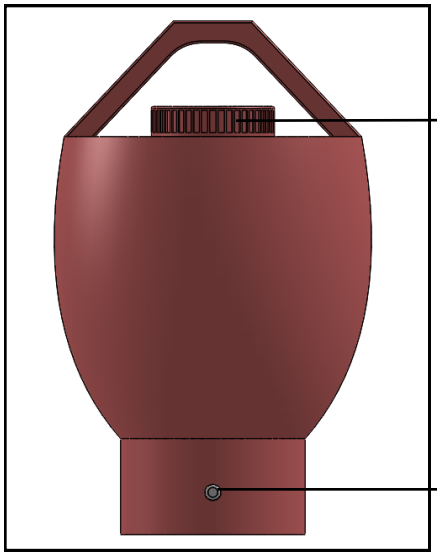
Final Prototype

For the final prototype, the dense packing material inside the wind tunnel consisted of an array of sponges tied to cotton strings.

Tank 2 was retrofitted to hold a filter and a pump. The filter ensured all of the precipitate was being captured and a shut-off valve was added to stop the flow of the fluid from tank 1, allowing more time for mixing.

Sanny Pro - Wearable Hand Sanitizer

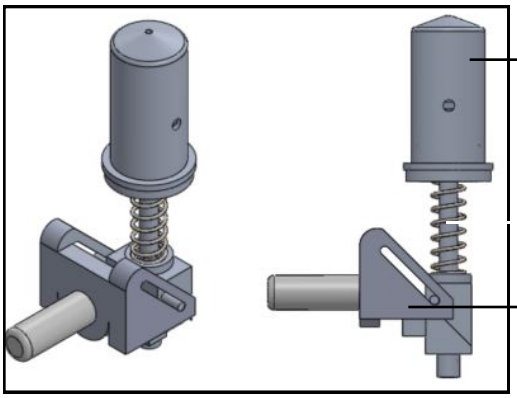
In a team of 5 students, I developed the prototype of a wearable hand sanitizer. I collaborated with 3 other designers to design the dispensing mechanism, enclosure, and removeable cap using SolidWorks. The hand sanitizer was designed to be worn by young children in a necklace formation using a lanyard, thereby reminding them to constantly sanitize their hands during the day.



Removable top cap designed to allow the user to refill the hand sanitizer once it runs out.

Easy to access button to allow users to dispense the hand sanitizer using only a single hand.

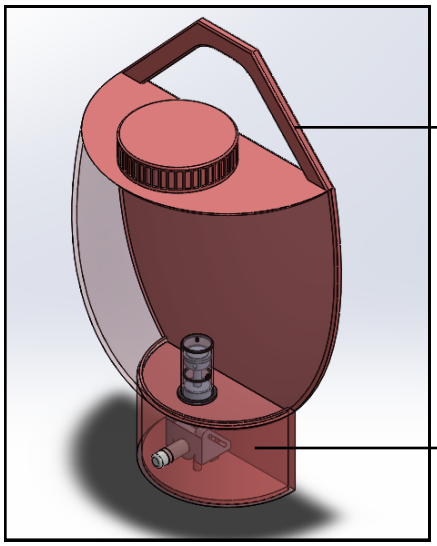
Final Design Front View



Top cylinder containing a funnel and a piston with holes on the sides to allow for the sanitizer gel to enter into the dispensing mechanism.

Cylindrical roller system designed with a guide rail to connect the horizontal motion of the button with the vertical motion of the dispensing mechanism.

Dispensing Mechanism



Top inverted “V-bracket” to allow users to connect a lanyard with the sanitizer and prevent lateral motion of the system when a user is walking or running.

Secondary enclosure designed to hold the dispensing mechanism, allowing for a safer design and preventing pinch hazards for the user.

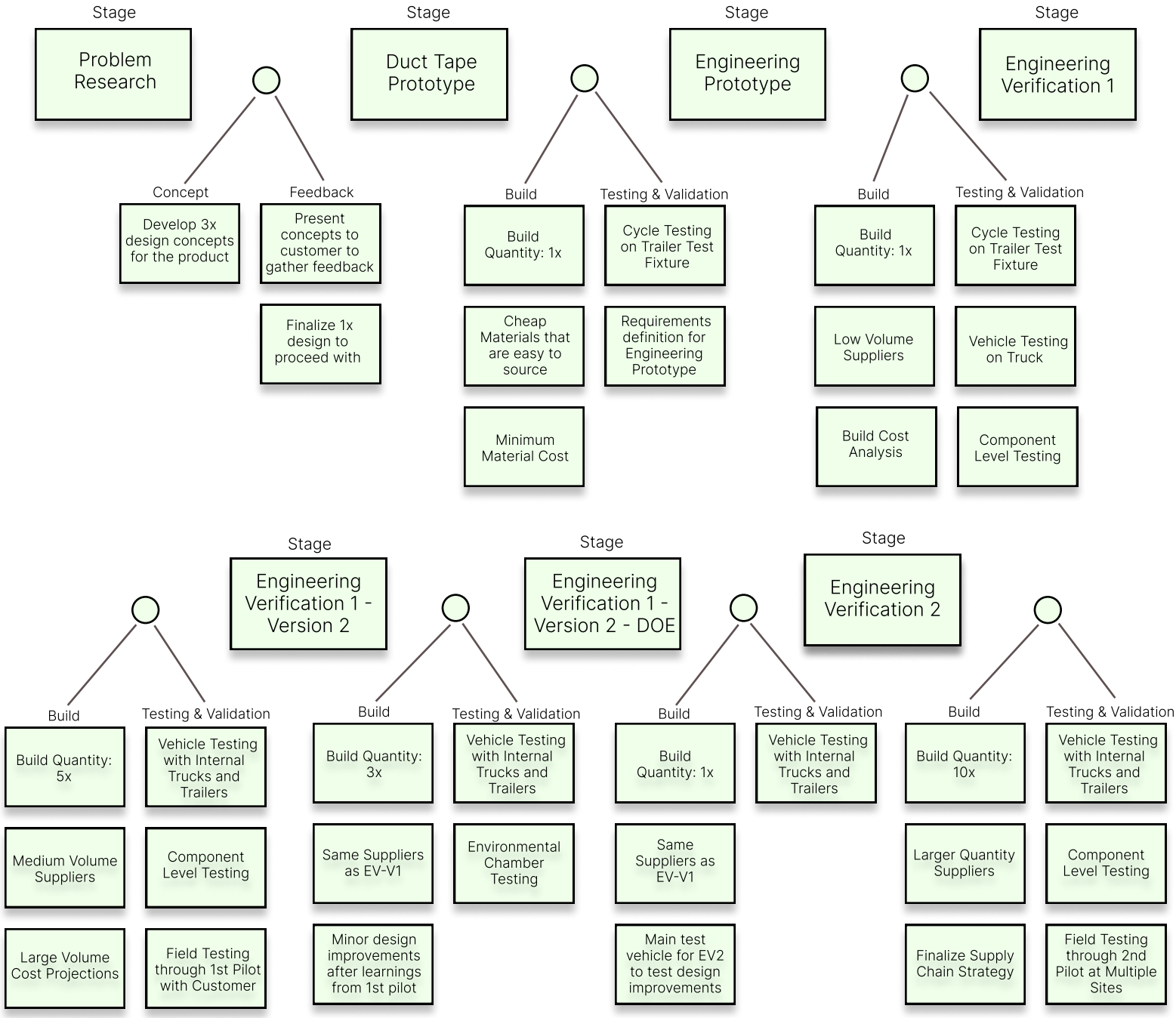
Final Design Isometric View

Auto Connect™ Robot - Product Development Process Optimization

The Auto Connect™ robot at Electrans is a product that is being developed from scratch. I have been responsible for the creation and optimization of the product development roadmap allowing for continuous testing as well as customer feedback to be incorporated into the development.

Responsibilities:

- Researched the agile hardware development process to use as a benchmark for the robot's product development process.
- Developed the scope of 3 in-house component testing fixtures. These were the connector cycle tester, rain simulation tester, and rail tester.
- Created build matrices and product version controls by working closely with sub-teams including mechanical, software, and electrical.



Auto Connect™ Robot - Procurement and Supply Chain Strategy Setup

The Auto Connect™ robot at Electrans is a product that is being developed from scratch. During my time at Electrans, I have been responsible for the setup of a procurement and supply chain strategy which is allowing for a more sustainable product manufacturing roadmap.

Responsibilities:

- Managed the entire bill of materials for the product, finding appropriate suppliers for every component, based on the development stage of the product.
- Optimized the supply chain over the course of several development iterations, reducing the number of distributer supplier parts from 12.5% to 4%, establishing working relationships with direct suppliers.
- Identified multiple suppliers for a given part and equivalent part replacements for singular suppliers, thereby reducing the long term risks of a production line down.
- Developed in-house part numbers for all components on the BOM, allowing for the usage of an inventory management system and SolidWorks PDM.