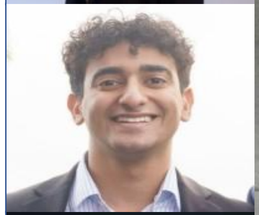
Project Hovercraft – Team Crocodile



Team Members

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Customer

Professor Christopher Muir

Project Overview

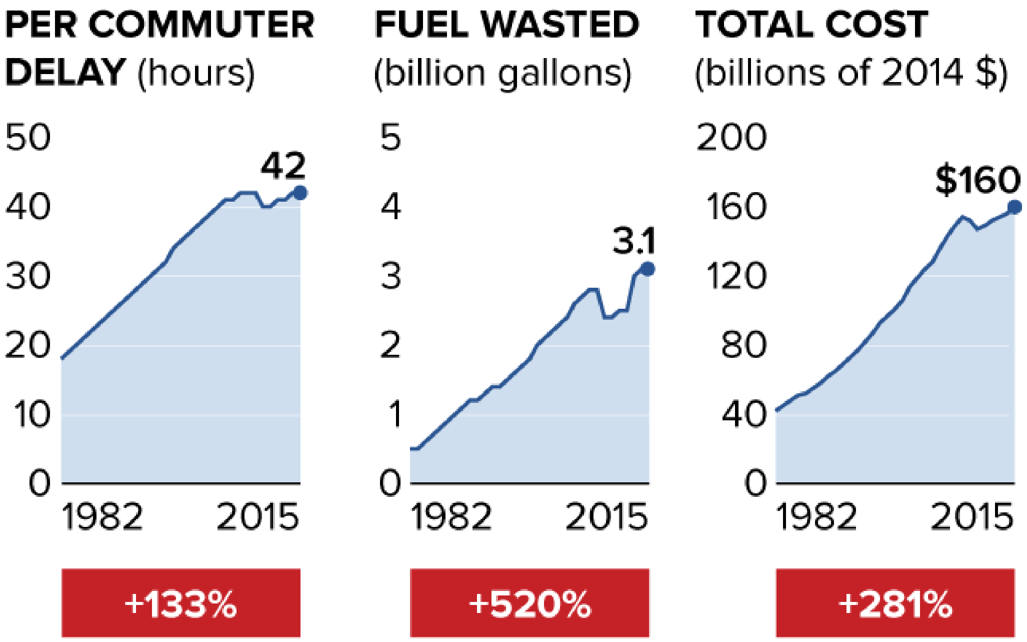
This project aimed to design and build a small, electric hovercraft that can glide over flat surfaces using air instead of wheels. Traditional vehicles contribute to pollution and rely on roads, but hovercrafts can travel over land, water, or ice without producing emissions. Our team created a lightweight, battery-powered hovercraft using everyday materials like foam, plywood, and leaf blowers. The design focuses on being environmentally friendly, affordable, and easy to build. It could one day be useful for transportation in areas with poor infrastructure or during emergencies when roads are blocked.

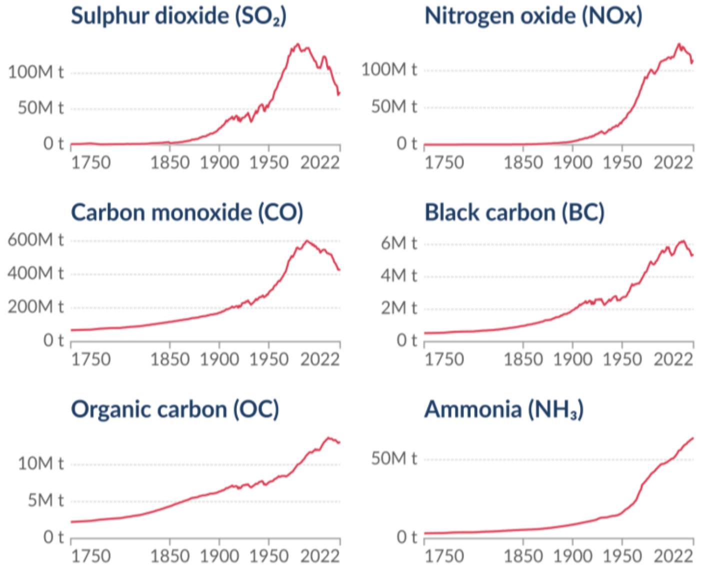
Problem Statement

Current modes of transportation release a lot of pollution and often easily congest and jam roads. Innovative vehicle designs can improve both aspects; reducing emission to help the environment and improving social impacts. Ideally the vehicle will remain or be more affordable than current options. Note on emissions; as seen to the right emissions are declining slightly but much more work is needed.

Hovercrafts:

- Reduce urban congestion via ability to traverse most terrains. Will lower dependency on infrastructure and allow for less future need for new related infrastructure.
- Electric, meaning they release no pollution directly from usage. Sustainable energy and battery technology are being researched and will improve hovercraft potential.
- Cheap to manufacture (and as mentioned reduces need to pay for future infrastructure).
- Note, still drawbacks to be attended to such as noise.





Deliverables, Requirements and Specifications

Deliverables:

- Operational prototype device ready to race on design day against opposing team.
- Project report with test results.
- CAD Drawing with BOM.

Requirements:

- At least two drivers per team.
- Vehicle evaluated for safety by instructional staff.
- Propulsion mechanism is same for both teams (different number of leaf blowers allowed).
- Vehicle must be able to maneuver the course.
- Payload for each team will be equalized.

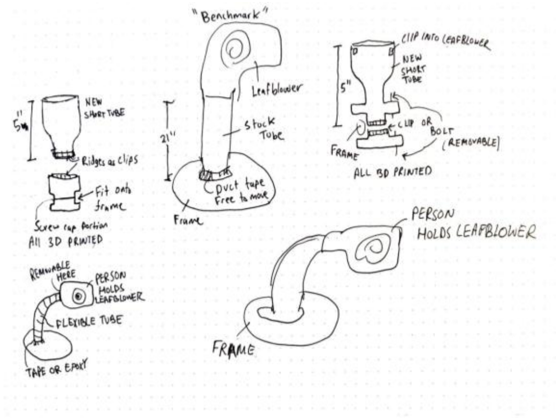
Specifications:

- Hovercraft should be able to travel in a straight line within a 5 ft boundary.
- Hovercraft cannot be faster than 15 mph.
- 5 lbf tolerance between payload of both teams.
- Vehicle braking distance cannot exceed 15 ft from top speed.

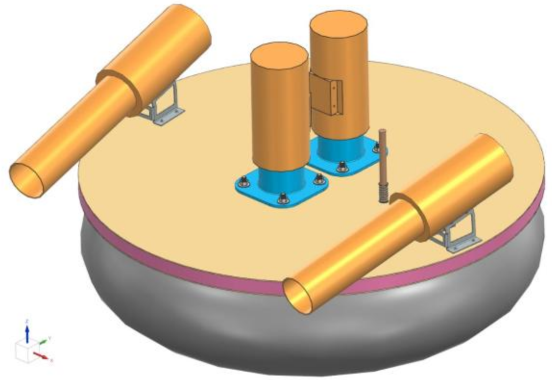
Specification	Test	Pass/Fail
Hovercraft should be able to travel in a straight line within a 5 ft boundary.	Hovercraft driven 32 ft at top speed within a 5 ft lateral boundary. Deviation from the straight path was visually observed.	Pass – The hovercraft stayed within the 5 ft lateral boundary on all five trials.
Hovercraft should be no faster than 15 mph.	Stopwatch was used to time hovercraft as it traveled 32 ft after reaching top speed. Speed was calculated (speed = distance/time) and converted to mph.	Pass – Across five trials, the hovercraft averaged 5.23 seconds over 32 feet, yielding a speed of 4.14 mph.
Tolerance between payload shall not exceed 5 lbf.	Use bathroom scale to weigh both drivers. Add weight to lighter driver until the difference in less than or equal to 5 lbf.	N/A – Payload will be equalized on race day.
The vehicle cannot exceed 15 ft braking distance from top speed.	Tape measure is used to measure distance between braking point and stopping point after hovercraft has reached top speed.	Pass – Braking distance improved from 12.48 ±1.69 ft to 6.88 ±1.00 ft once a rubber stopper was attached.

Current Project Status

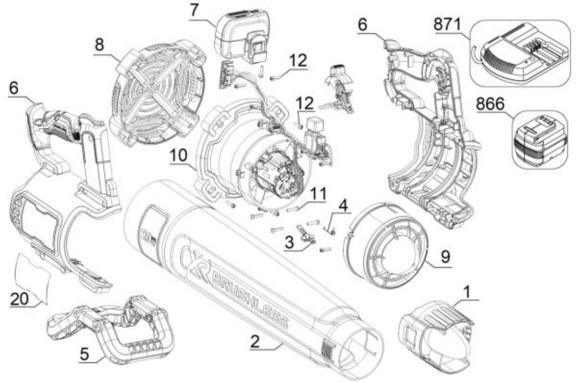
Concepts/Research:



Drivetrain concept generation.



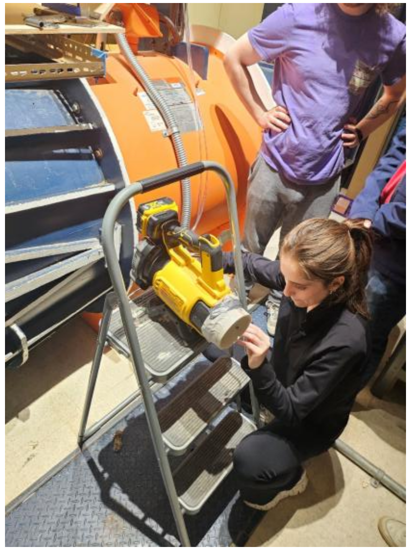
Early concept – dual leaf blowers with tube skirt.



DeWalt leaf blower components (Source: Parts Warehouse).

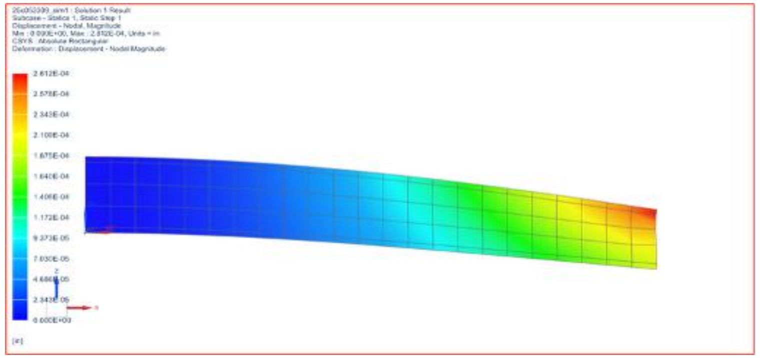
Final concept with human model.

Analysis:



Pressure testing in wind tunnel.

Pressure tests using a Dwyer Mark II inclined manometer and a U-tube manometer with a pitot tube showed the DeWalt leaf blower produced 97 CFM at the outlet in open air. Total pressure at the blower was 14.59 lb/ft^2. Given the hovercraft's 5.59 ft^2 surface area, the theoretical maximum weight was 81.6 lb. This was confirmed by a back pressure test, where hovering stopped at an 87 lb total load. To lift 180 lb, about (180 lb/ 87 lb) = 2.1 times the current output is needed, requiring at least three DeWalt leaf blowers to lift a 160 lb person combined with the 20 lb craft.

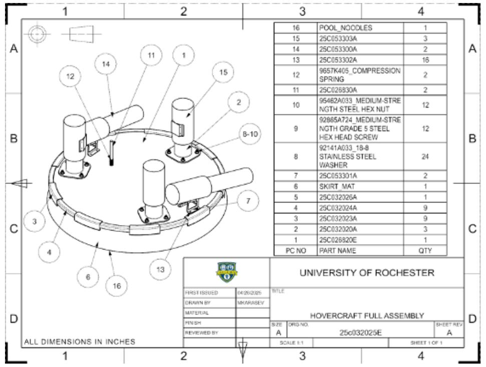


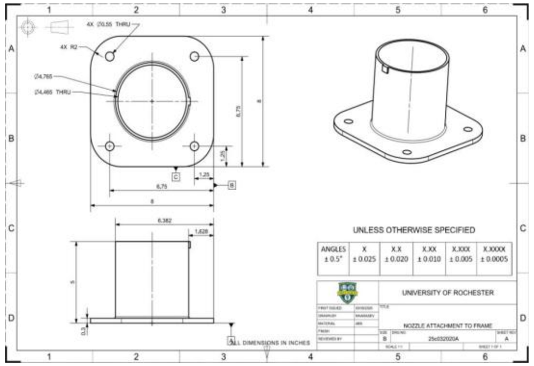
Stress test of composite material showing displacement.

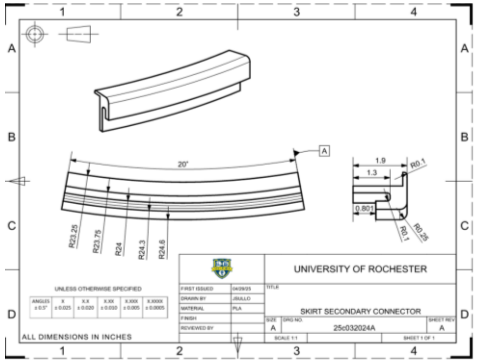
We chose a composite frame structure to minimize weight without compromising strength: two outer layers of 1/8 in. plywood and two inner layers of 1.5 in. thick foam. NX simulations showed this design is 193.8 times stiffer than a 0.5 in. plywood sheet while being 1.51 times lighter.

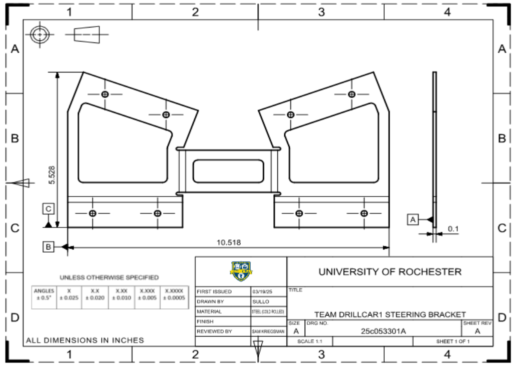
Current Project Status

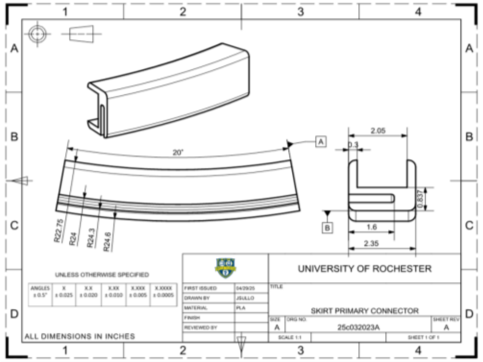
Drawings/Detail Design:

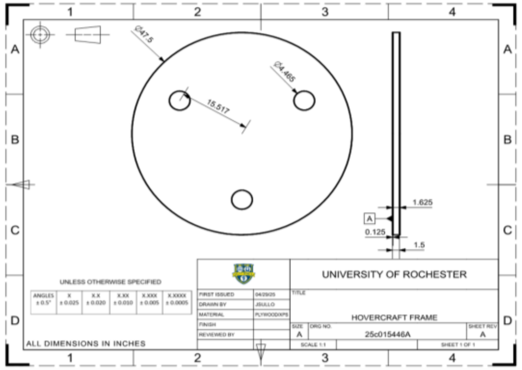




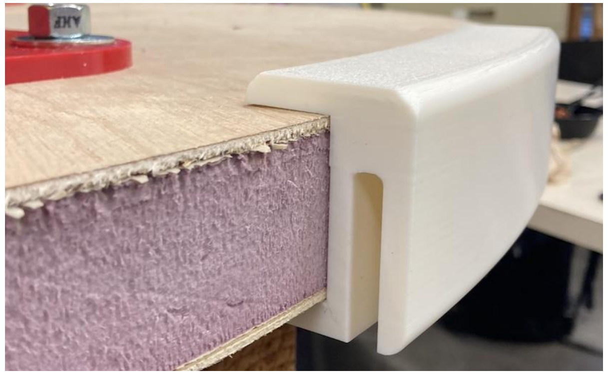








Manufacturing:



Conclusions/Future Work

The Crocodile Hovercraft successfully met each of the project's performance goals, meeting all specifications for speed, maneuverability, and braking. Using lightweight composite materials, multiple leaf blowers, and a custom skirt design, the hovercraft was able to achieve stable hovering and controlled navigation over a flat surface. The hovercraft is fully operational and ready for race day.

Battery life and the skirt design are some constraints that limit operational time and practical application. Future work should prioritize extending battery life through more efficient power management systems, such as adjustable blower speeds, and exploring alternative skirt designs, like inflatable or flexible skirts, to enhance terrain adaptability.

We are grateful for the assistance of Professor Muir, as well as Chris Pratt, Jim Alkins, Alex Prideaux, and Sebastian Gomez, whose support and contributions were essential to the successful completion of our project.