HUMAN POWERED VEHICLE CHALLENGE

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Problem Statement

This project aimed at designing, prototyping, testing, and fabricating a human powered vehicle with electric assist. This vehicle was submitted to compete in the ASME Human Powered Vehicle Competition as our capstone project.

Background Research

- Sources like Fezzari Bicycles Incorporated and the Provo Bicycle Collective provided inspiration
- Research expanded outside the bicycle industry into areas such as motorcycles to gain insight.

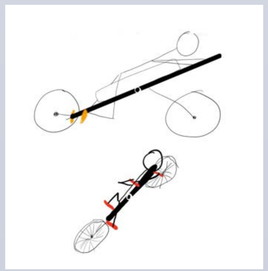
Concept Generation

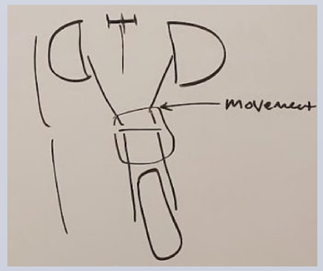
- Ideas must be competitive for consumer needs while meeting the competition requirements to be considered for final builds.

Competition Requirements		
Metric	**Value**	**Units**
Turn Radius	Minimum 8	m
Stopping distance going 25 km/hr	Maximum 6	m
Can travel in a straight line moving 5 to 8 km/hr	Minimum 30	m
Front Brakes	Minimum 1	per wheel
Roll Cage with vertical force strength	Minimum 2670	N
Roll Cage with horizontal force strength	Minimum 1330	N
Safety harness	4 or 5	Secure Points
Class 1,2, or 3 Ebikes	Maximum assist 28	mph
Battery system	Maximum 48	Volts

Consumer Needs		
Metric	**Value**	**Units**
Adjustable sizing for rider	60 to 77	in
Ride comfort	>1	hour
Suspension travel	0.1	m
Time between services	>6	months
Max Speed	>15.5	mph
Dry weight	<100	lbs
Length	<7	ft
Battery life	>30	miles

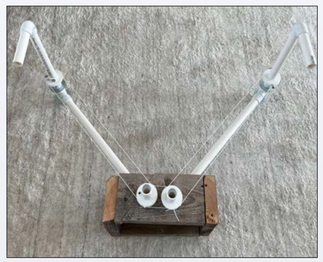
- 100 different hand sketches were drawn during collaborative brainstorming.

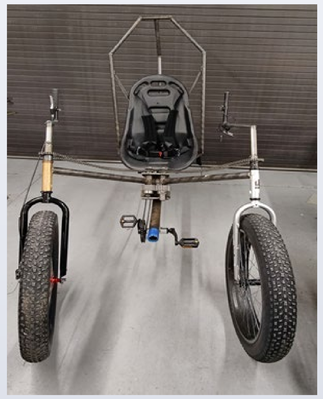




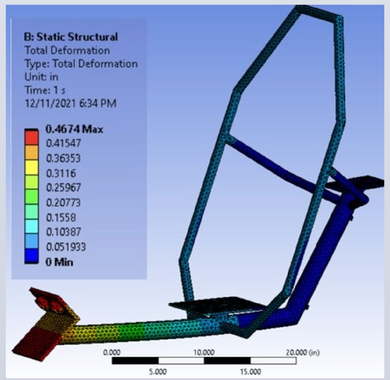
Prototyping

- Prototyping heavily reduced unknown variables before the final build.
- Early prototypes for the adjustable front forks were made from PVC and wood
- 3D printed gears were used for alignment and to test gear size and precision.

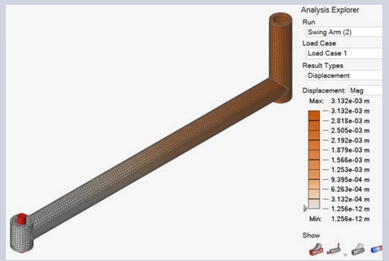


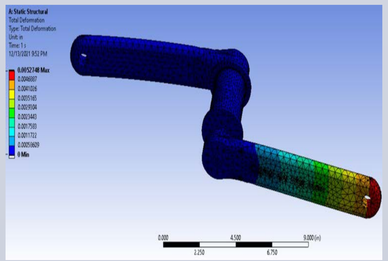


Analysis



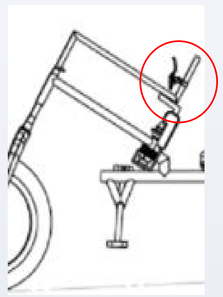
- Load bearing parts were analyzed to ensure safe operation using FEA.
- The rollover protection system, the frame, and the front swing arms were analyzed and revised during this process.
- Off the shelf parts were analyzed to verify stress reduction associated with e-assist.





Refinement

- During testing, the locking pins sheared requiring a stronger material. We went from zinc plated to stainless steel pins.
- We also changed the handlebar placement from a horizontal position to a vertical orientation to be more ergonomic for the rider.



Current Results

- The bike is capable of riding in either bike or trike configuration.
- The bike was submitted to the ASME HPVC 2022
- Many tests for durability and proof of concept have been conducted.

Future Plans

- A pawl, as shown below, would offer more strength and customization while replacing the pin system.
- Optimization of weight by using lighter materials with stronger framework.
- Adjustable seating to accommodate more riders.