INNOVATING A HUMAN POWERED VEHICLE

Objective Statement: **Reinvent a bike capable of competing in the American Society of Mechanical Engineers Human Powered Vehicle Competition (ASME HPVC)**

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Mentor: Israd Jaafar Ph.D

1 DEFINE THE PROBLEM

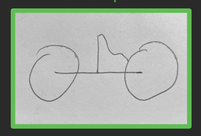
ASME HPVC Rule Book
Researching Customer Needs

Ensure vehicle fits within codes and standards:
- Utah's Department of Transportation (UDOT)
- NFPA 485 (Lithium Battery Handling)
- National Electric Code (NEC)
- CFR Title 16 Part 1512 (FHSA)

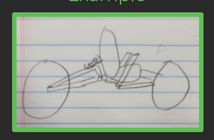
2 CONCEPT GENERATION

- 3 Stages of Brainstorming
- Generated over 90 Ideas

1st Stage Example



2nd Stage Example



3rd Stage Example



3 CONCEPT SELECTION

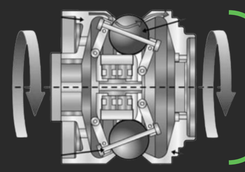
Design selection:
Recumbent Style Bicycle
3rd wheel for stability



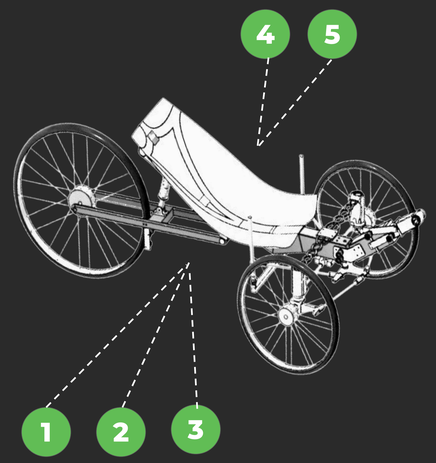
Areas of Innovation:
Construction
Carbon Fiber Tubes, Carbon Fiber layup
Suspension
Front and Rear Suspension
Driveline
Linear Steering
Adjustment
Pedal Position, Wheel Angle, Seat Angle
Off-The-Shelf Innovation
Continuous Variable Transmission (CVT), Electric Pedal Assist, Hydraulic Brake

CVT





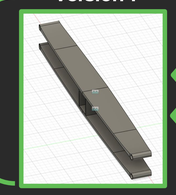
CVT Function



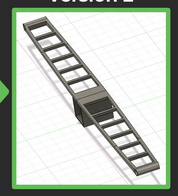
4 ANALYSIS

Leaf Spring Front Suspension

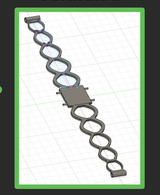
Version 1

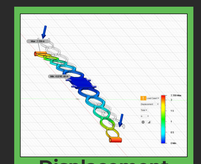


Version 2

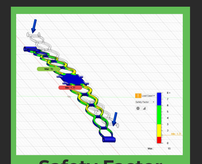


Version 3









- 150 ft-lbs of force
- Elevating Applied Stress
- Minimizing Displacement
- Minimizing Strain
- <+1 Safety Factor

	FEA				
	Component	*Max Stress (psi)*	*Max Strain*	*Max Displacement (in)*	*Min Safety Factor*
1	Drive Train	24155	6.613E-04	0.00197	10
2	Frame Angle Bracket	50459	5.863E-04	0.00482	7.828
3	Headset Steering Arm	11396	2.422E-04	0.06387	10
4	Headset Wheel Mount	23850	7.129E-04	0.01374	1.259
5	Leaf Spring	169982	9.023E-04	2.20900	1.270
6	Leaf Spring Support Hub	45051	2.049E-04	0.01203	6.300
7	Main Steering Hub	54628	3.437E-04	0.04800	10
8	Rear Swing Arm	48573	1.336E-04	0.30632	1.040
9	Roll Cage	42601	6.125E-04	0.07090	9.012
10	Seat Member	66630	1.142E-04	0.09201	8.823
11	Steering Headtube Mount	1900	1.078E-04	7.489E-05	10

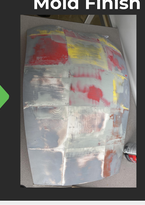
5 FABRICATION

Seat

Mold Start



Mold Finish



The seat mold was constructed out of 16 3D printed parts. Filler and sanding was used to smooth it prior to carbon fiber layup

Step 1



Step 2



Step 3



Example of Custom Parts

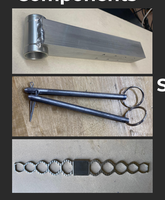
CVT and Rear Suspension



Swing Arm Mounts



Telescoping Pedals Components



Securing Pins

Telescoping Sleeve



Wheel Brackets



Steering Handles



Spring

Out of the 44 main components that made up the vehicle, 33 of them were custom made or altered. Process including machining, CNC manufacturing, welding, 3D printing, and heat treating were utilized in construction

6 RESULTS



Reinvented a Human Powered Vehicle capable of competing in the ASME HPV Competition

ASME HPVC HUMAN POWERED VEHICLE CHALLENGE

UVU MECHANICAL ENGINEERING
UTAH VALLEY UNIVERSITY

Ashton Engineering LLC Composites R&D