UVU MECHANICAL ENGINEERING
UTAH VALLEY UNIVERSITY

Adaptive Electric Terrain Vehicle (E-TV)

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Introduction

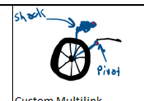
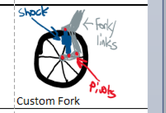
This project aims to design and develop an electric all-terrain vehicle (E-TV) tailored for adaptive riders in collaboration with Wasatch Adaptive Sports (WAS) and the UVU Mechanical Engineering Program. The objective is to meet the unique needs of individuals with adaptive requirements, exemplified by instructor Marshall Evans at WAS, who, despite being paralyzed from the waist down actively engages in outdoor activities.

Objective

Design/build an adaptive electric terrain vehicle to restore an individual's abilities to enjoy technical single track.

Design Process

Team identified design requirements based on customer needs. Each member individually researched designs to accommodate requirements. A morph chart (figure below) was used to organize each team generated idea.

Functions:			
Front Suspension	 Standard front fork	 Custom Multilink	 Custom Fork
Steering	 Direct Link	 Extended Linkage	
Rear Suspension	 Low Pivot	 High Pivot	

Design Process Continued

A scoring matrix (seen below) was created to determine the best concept for each component category. Team members individually scored each component based on weighted selection criteria. The scores were then averaged for each component category and the concept was then selected.

Landing Gear		Concepts											
		Dual Kickstand		Scooter Style		RV Style		Tent Pole Style		Air Bag Style		Auto Step Style	
Selection Criteria	Weight (%)	Rating	Weighted Score	Rating	Weighted Score	Rating	Weighted Score	Rating	Weighted Score	Rating	Weighted Score	Rating	Weighted Score
Ease of Maintenance	10	7	70	8	80	5	50	9	90	4	40	6	60
Ease of Use	15	5	75	6	90	8	120	4	60	8	120	8	120
Ease of Manufacture	15	5	75	6	90	6	90	7	105	5	75	3	45
Complexity	10	6	60	6	60	4	40	7	70	5	50	3	30
Weight Distribution	10	5	50	5	50	4	40	7	70	5	50	6	60
Durability	15	7	105	7	105	7	105	6	90	6	90	6	90
Cost	15	7	105	7	105	4	60	8	120	3	45	4	60
Aesthetics	10	6	60	7	70	8	80	1	10	8	80	9	90
Total	100												
	Total Score	600		650		585		615		550		555	

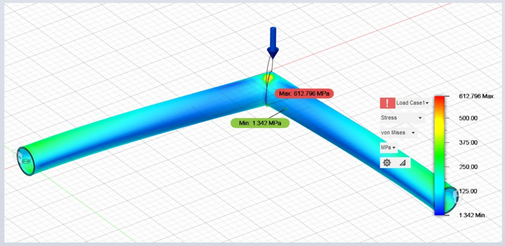
Materials and Methods

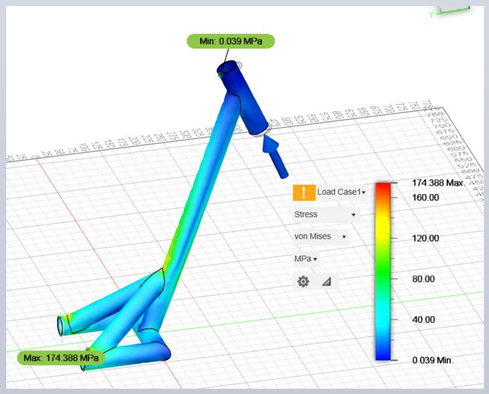
6061 aluminum was chosen as the main material for the E-TV frame due to it's strength to weight ration, high yield strength, and ease of fabrication.

To have an ideal frame all of the joints would have been bent, however due to not having proper tooling, the group decided to weld all the joints instead.

Finite Element Analysis (FEA) was used to ensure that welded joints would hold up to the potential stresses the E-TV might see.

FEA was also done on the front, rear, and frame of the bike to ensure that the selected concepts were going to perform without failure.



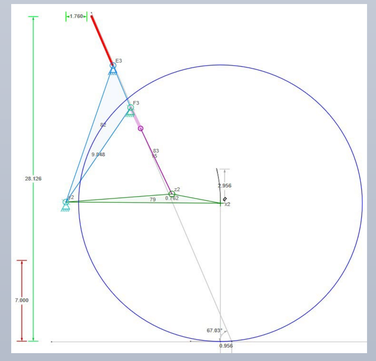


Prototyping

Due to time & money constraints, multiple physical prototypes were not feasible.

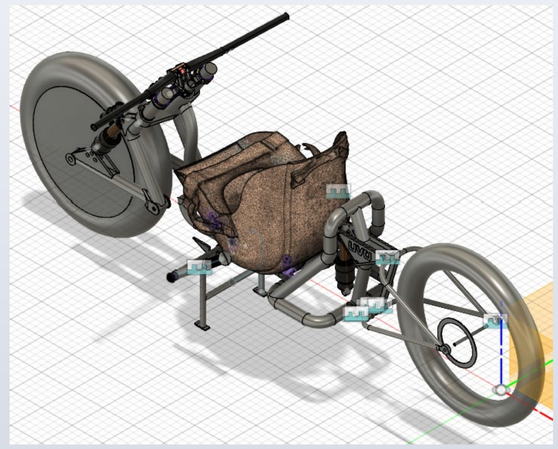
Modeling of the suspension was done using a Linkage software to help visualize how different suspension concepts affect wheel travel.

3D printing was used to do physical prototyping of small parts of the E-TV, before full fabrication was complete.



Prototyping Continued

Fusion 360 was used as the 3D modeling throughout this process with a shared project that the team could work together.



Results and Conclusions

Prototype electric terrain vehicle was constructed to be used for an adaptive rider.

Technical Details:

- Wheelbase: 62.25 inches
- Total length: 86.5 inches
- Frame width: 16.25 inches
- Ground clearance: 8.5 inches
- Front wheel travel: 3 inches
- Rear wheel travel: 3.25 inches
- Wheel size: 20 inch 'fat' tires
- Weight: 69 pounds
- Turning radius: 10.5 feet
- Top speed: 30 MPH