Basic Utility Vehicle (BUV)

Mechanical and Aerospace Engineering

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Abstract

The goal of the Basic Utility vehicle team is to modify the BUV from the year prior and design a durable and effective vehicle for a competition in Batavia, Ohio. The competition consists of a 2.2-mile-long course that needs to be run for 7 straight hours, dumping water from the barrels and pumping water back in, every 3 laps. During the competition the BUV faces knee-deep mud and up to 10-degree inclines. The modifications this year's team made consist of the following: A lighter frame to reduce the weight of the BUV. The addition of a continuously variable transmission to allow the BUV to climb sharper inclines. Adding leaf spring suspension to the rear wheels for a smoother ride. Changing the orientation of the drive train and moving it underneath the vehicle. A new electric board to fit the narrower frame and organize the components better. Finally, cooling for the rectifiers that were overheating before. The competition the team was supposed to compete in was cancelled, so instead they planned a mock competition at a local boy scout camp for a few hours and projected out how many points they would gain at a real competition.

Customer Needs and Requirements

Needs

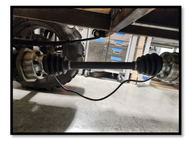
- Navigate rough terrain
- Transport vital resources effectively
- Lightweight design
- Safe

Requirements

- BUV will be capable of ascending a 10-degree incline with full barrels
- BUV will be capable of pumping and dumping water in and out of 55-gallon drums
- Reach max speed between 18-20 mph or more
- Decrease weight of the BUV by at least 250 lbs
- Frame should be designed to handle 1.5 times the weight expected to be placed on the BUV

Concept Selection

Leaf Springs



CV Axle

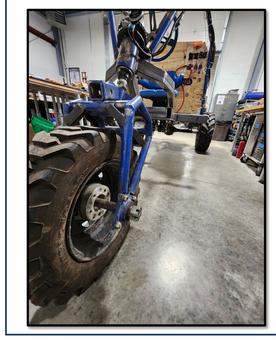
Rectifier Cooling

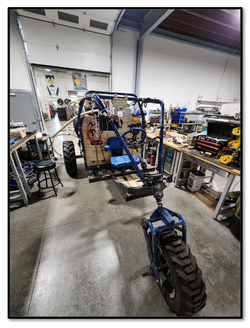
Drive Motor

CVT

- 10 Hp Honda engine
- New lighter frame
- Leaf spring suspension
- 4 AGM 12-volt 100 Ah Batteries
- Rear 5 KW Electric Drive Motor and Controller
- Finned cooling for rectifiers
- CV Axle
- Regenerative and hydraulic braking
- 2 Steel 55 Gallon Water Barrels
- 3 kW Electric Water Pump
- K-Type Stick on Thermocouples
- Continuously Variable Transmission

Design Solution





Manufacturing

New Frame

- New frame with roll cage and wheels
- Frame made 300 lbs lighter

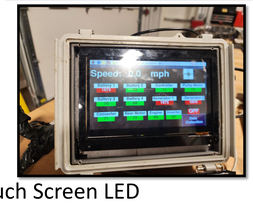
Drivetrain

- Used waterjet to cut out ¼" steel mount
- CVT connects motor to gearbox
- CV axle connects gearbox to differential

Electric Water Pump and Piping

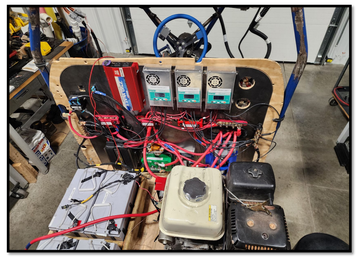
- Quentin Benson holding discharge hose
- Pump assembly water test

Head's Up Display



- Touch Screen LED
- Used for monitoring temperatures of major electrical components
- Calculates vehicle speed from GPS Sensor

Electrical Components & Wiring

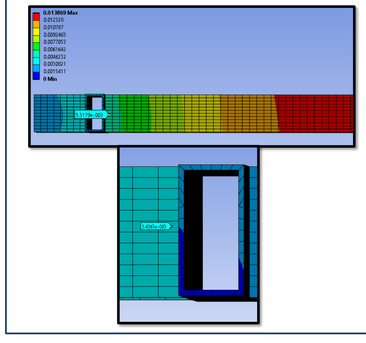


- Electronic wiring behind driver
- 48 v circuit and additional components

Testing and Validation

Frame test (Test 1):

- Frame loaded with 2 full barrels
- Compared to computer simulation
- Both were comparable



Pump Test (Test 2):

- Tested pump functionality
- Pump worked for both pumping water in and out of the barrels

Weight Test (Test 3):

- Used a 5-ton hoist to find the total weight of the BUV
- The BUV was found to weigh about 2050 lbs
- This is about 600 lbs less than last year

Driving Test (Test 4):

- Top speed of 18 mph
- Drove up 14-degree asphalt incline
- Driven through mud and over a small mound

Mock Competition:

- Drove up 17-degree dirt incline
- Pump Time: 5:50
- Dump Time: 1:50
- Average Mph: ~8 mph
- Projected Point earn was 1035

Acknowledgments

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