Basic Utility Vehicle

Mechanical and Aerospace Engineering

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Abstract

The “Institute for affordable Transportation” is an organization that is based around improving lives in third world countries by providing those in need with affordable vehicles to help communities grow. This project is to design an affordable vehicle that can transport water as well as people long distances. The designed BUV will run in a competition that tests the hauling capacity in which it will carry 110 gallons of water through heavy mud as well as wooded areas all of which will test the durability of the design. The focus of the design was to incorporate a hybrid gas-electric drive system. By directly coupling two electric generators to the Honda engine and including four 12-volt batteries, the team successfully powered the electric drive motor and required components to propel the BUV. The rear frame was modified to fit the limited slip differential to rotate both rear wheels. A CV axle was connected to the differential and a gearbox, which then was directly coupled into the electric drive motor. The last improvement to the vehicle was fixing the pump and adding a 3-kW electric pump motor. A HUD (Head’s Up Display) was incorporated to the front of the vehicle to successfully monitor the electrical systems temperatures and voltages.

Customer Needs and Requirements

Needs
- Navigate rough terrain
- Reduce emissions by incorporating electric-power
- Able to transport 2 steel 55-gallon barrels
- Safe

Requirements
- BUV will be capable of ascending a 30-degree, muddy incline
- Run Fully Electric BUV for at least 20 mins
- Reach max speed between 18-20 mph
- First safe and successful test shall be 4 weeks before the competition
- Pump and dump water in/out of barrels

Concept Selection


Honda Engine


2 Nidec Generators

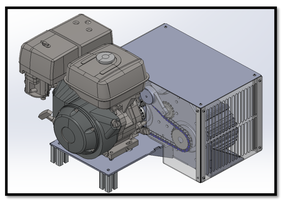
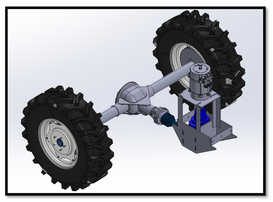
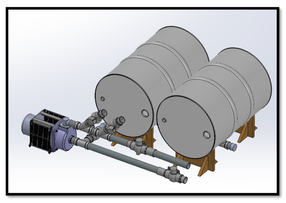
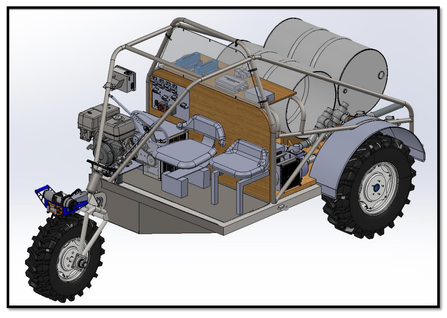

AGM Battery


Drive Motor


Rear Differential

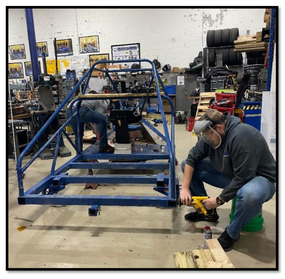
- 10.7 hp Honda GX340 engine
- 2 Nidec 4 kW AC Permanent Magnet Motors (Generators)
- 4 AGM 12-volt 100 Ah Batteries
- Rear Electric Drive Motor and Controller
- 3 60A Charge Controllers
- Capacitor - 100V 100,000 uF
- Truck Drum Braking System
- 2 Steel 55 Gallon Water Barrels
- 3 kW Electric Water Pump
- K-Type Stick on Thermocouples
- DC Battery Monitor 200V & 300A

Design Solution

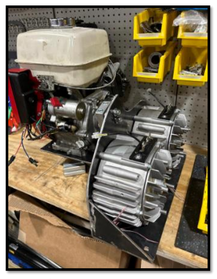
Manufacturing

Rear Frame & Differential



- Cameron Ickes cutting the frame
- Frame shortened to account for 1995 Silverado Rear end

Rear Motor Mount and Generator Mount



- Used waterjet to cut out ¼" steel mount
- Connects AC Permanent magnet motors and 11 hp Honda engine via chain drive

Electric Water Pump and Piping

- Josh Belanger priming main pump with sump pump
- Pump assembly water test
- Achieved 94 gpm

Head's Up Display

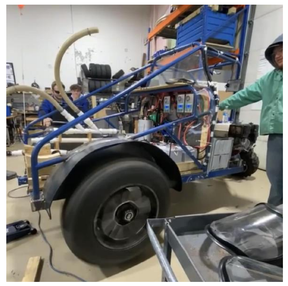
- Touch Screen LED
- Used for monitoring temperatures of major electrical components
- Calculates vehicle speed from GPS Sensor

Electrical Components & Wiring

- Electronic wiring behind driver
- 48 v circuit and additional components
- Rear drive motor positioned in center of frame

Testing and Validation

Drive unloaded on jack stands (Test 1):
- Optimal conditions
- Tested all electrical wiring for continuity
- Program motor controller
- Achieved top speed of 23 mph



Drive around parking lot (Test 2):
- Dry/favorable conditions
- Achieved top speed 22 mph with load, barrels empty
- Program pedal for smoother acceleration and costing

Drive to woods (Test 3):
- Dry/little muddy
- Pump water into barrels in 1 minute 34 seconds
- Dump and pump water into 2 barrels in 3 minutes and 35 seconds

Drive to woods (Test 4):
- Achieved speed of 18 mph with no barrels
- Climbed 30-degree hill after tweaking acceleration and torque code
- Could not climb hill with 2 barrels filled

Competition Simulation (Test 5):
- Drove around behind golf course for 30 minutes
- Pumped water in and out of barrels

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