Electric Go-Kart

Mechanical and Aerospace Engineering

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Abstract

Six MAE seniors designed, analyzed, and constructed Trine University's first electric go-kart to compete in the International Electric Go-Kart Racing Collegiate Competition. Students followed requirements set by the ev Grand Prix to design and construct an electric vehicle that aggressively optimizes speed and efficiency through the controller and chain systems. To size batteries and other electrical components for anticipated driving conditions, a MATLAB code was developed to calculate energy and power consumption, velocity, acceleration, and gearing ratios throughout the race period under replicated racetrack conditions. Multiple electrical circuits were explored and modeled for optimal racing operation, energy efficiency, and weight reduction. Additionally, several battery configurations were explored to work with the controller in a way that maximizes kart operation at low energy consumption. To validate theoretical predictions, driving test procedures were created and conducted for energy consumption, top speed, acceleration, and braking distance. These tests also served as verifications that all race requirements and safety procedures were followed by the team, driver, and kart.

Customer Needs and Requirements

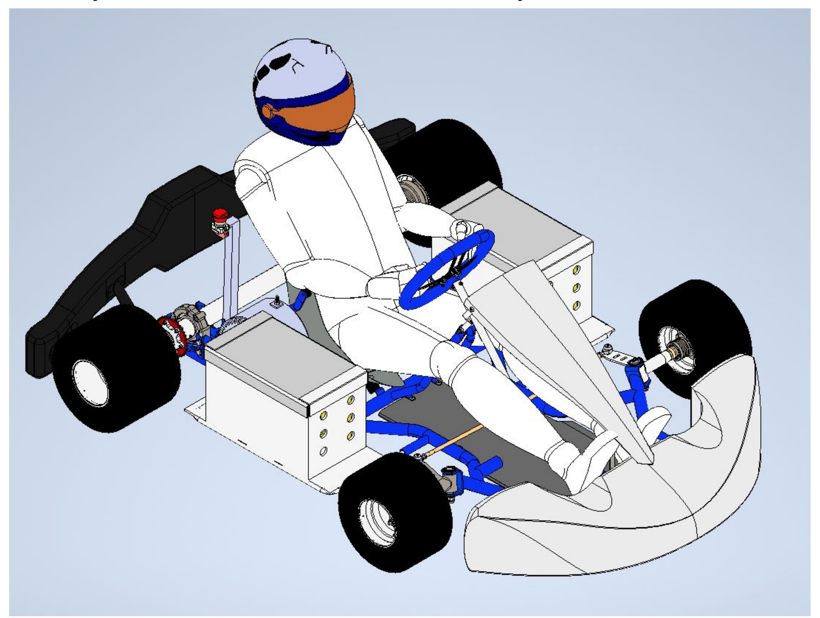
- Electric powertrain components
- Achieve 40 mph speed
- Work within $8,000 budget
    - Spent: $6,430.11
- Pass all racing and technical inspections
- Mechanical and electrical components safe for operation
- Chassis designed to withstand race
- ev Grand Prix rulebook is followed for all components

Concept Selection

- Motor: Motenergy ME0708
- Batteries: Lithium Iron Phosphate – 15S, 48V, 81.5 AH
- Controller: Kelly KDZ Controller
- Emergency stop button and switch
- 1/0 Marine-grade cable

Design Solution

To power the kart, 15 lithium iron battery cells are connected in series to a programmable controller, where the throttle potentiometer signal is used to vary the speed of an electric permanent magnet motor. The motor transmits power through a chain-sprocket system fixed to the rear axle – when the motor turns, so does the axle, which moves the kart forward.



Manufacturing

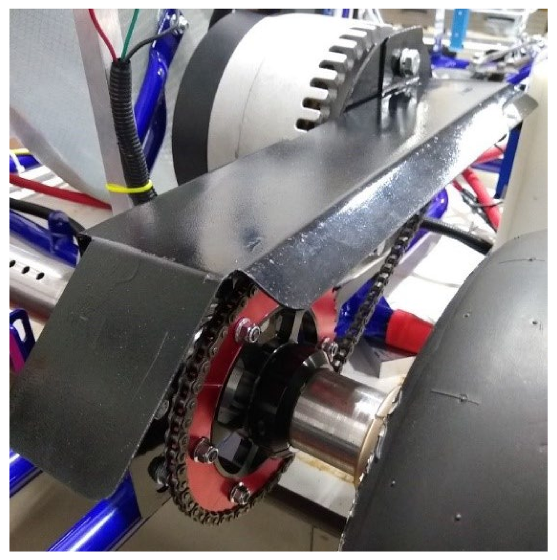
Battery Box

- Clear, removable box covers
- Air vents with metal mesh screen
- Inside – foam and rubber padding

Controller

- Kelly KDZ controller
- Mounted underneath the steering column

Chain Guard



- Painted black 10-gauge steel
- Plasma cut
- Used manual brake

Team Photo

- (Left to Right) Matt Poublon, Jacob Caldwell, Daria Frame, Lee Dougherty, Aaron Smith
- (Driver) Bethany Blumer

Testing and Validation

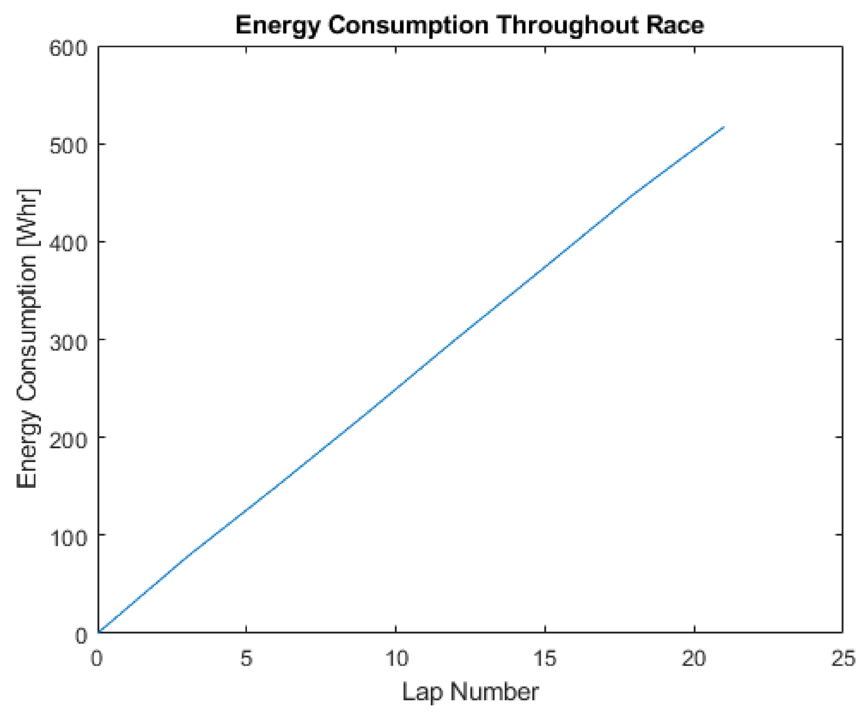
Test 1: Speed/Acceleration
- Top Speed: 40.36 MPH (meets goal) with competitive sprocket
- 0-40.36 MPH Time: 13.37 s

Speed/Acceleration Test Results:

Trial	Time [s]	Distance [ft]
1	13.66	509
2	13.81	509
3	13.355	475
4	13.89	511
5	13.61	507
6	12.385	446
7	12.95	474
8	13.955	537
9	13.5	492
10	12.62	465

Test 2: Energy Consumption
- Efficient Sprocket (15T): 23.15 WHr/lap
- Competitive Sprocket (22T): 26.95 WHr/lap
- Competitive Sprocket/Regen (22T): 24.62 WHr/lap
- Competitive w/ Regen was selected to balance speed, energy

Competitive Sprocket/Regen Energy Test Results:



All configurations allow enough energy for a race to be completed

Test 3: Braking Distance
- 40.36 MPH Stop Distance: 66 ft
- Rear axle fully locks

Tire after braking test:

Overall conclusion: all testing goals and project requirements met; vehicle fully operational

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