College of Engineering
Department of Mechanical & Industrial Engineering

College of Engineering
School of Electrical Engineering & Computer Science

To Predict ▶ To Design ▶ To Perform

ME, ECE Capstone Design Programs

Team #22: 30-lb Combat Robot #2 Jack-the-Flipper

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Objective Statement

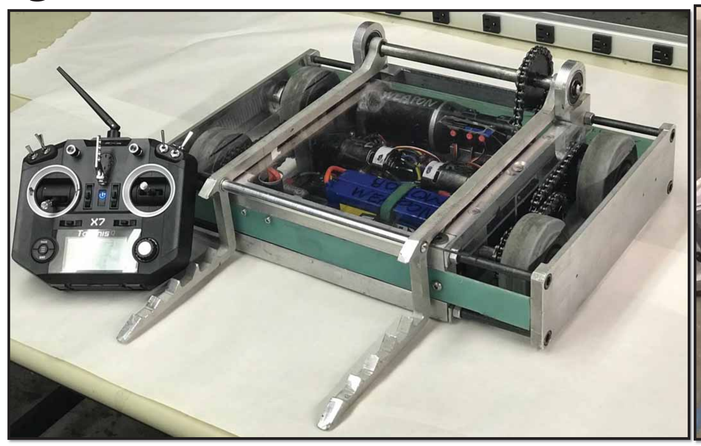
Design and manufacture a combat robot in the 30-lb weight class to knock-off or disable opponents in the Bengal Bot Brawl following Robot Battles™ rules, as well as include parts created through additive manufacturing.

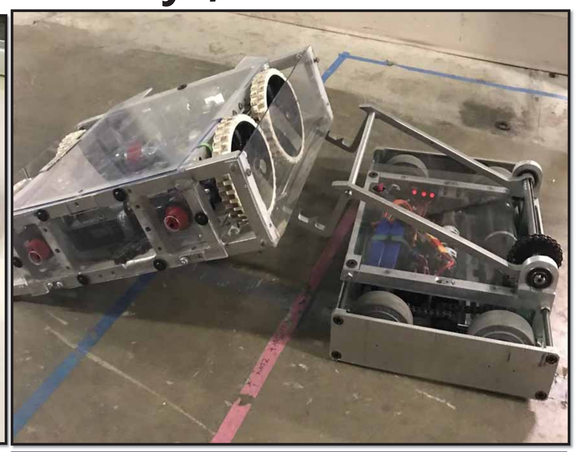
Engineering Specifications

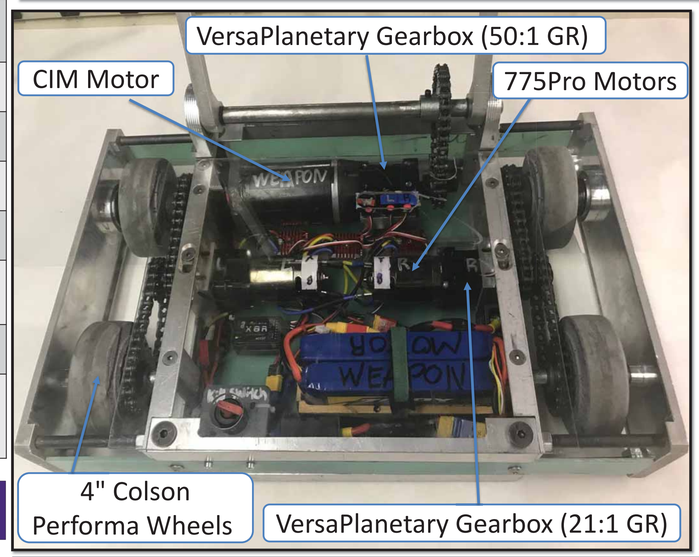
Specification	Target Value	Measured Value
Weight	≤ 30.75lbs	30.65lbs
Top Speed	8 - 10ft/s	8.85 ft/s
Turning Radius	0 in.	0 in.
Signal Range	>> 53 ft	> 500 ft
Run time	≥ 45 min	> 2 hours
Push Force	> 30.75 lbf	57.5 lbf
Lift Force	> 30.75 lbf	37.5 lbf
Max Operating Temperature	< 257 °F	119 °F

Safety Considerations

- Hard kill switch for weapon
- Signal kill switch for all motors on controller
- 80A fuses for over-current protection
- Loctite on all fasteners
- Flame-retardant storage bag for LiPo batteries
- Clear Plexiglass cover to see and protect internal components







Features

- 6061-T6 Al Frame and Flipping Arms
- ANSI #35 Roller Chain
- Quicrun WP 1080 Brushed 80A ESC
- Zippy FlightMax 8000 mAh LiPo Batteries
- FrSky Taranis Q X7 2.4GHz Controller

Additive Manufacturing

- 3/4”, 19T Keyed Rear Axle Sprocket
- 1/2” Hex, 12T Weapon Gearbox Shaft Sprocket
- Carbon Fiber Reinforced Onyx
- Yield Strength: $\sigma_y \approx 5.9$ ksi
- Fatigue Life: L > 10 hours

Analysis

- Torque Needed to Flip Opponent:
- $T = \frac{mgl}{GR_{sprockets} * GR_{gearbox} * e_{chain} * e_{gearbox}}$
- $T = \frac{(30.75lbf)(20in)}{(\frac{23}{12})(50)(0.98)(0.62)} = 10.6$ lbf-in

- Max Current Draw of Battery:
- *Constant Needed: 140A Burst Needed: 268A*
- *I = C-Rating * Amps = 30C * 8ooomAh = 240A*
- *Max Burst Current Draw of Battery (10seconds):*
- *I = 2 *C-Rating * Amps = 2 * 30C * 8ooomAh = 480A*

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Competition Results

- Finished in 3rd Place in B3
- 1-2 during round robin
- 0-3 during rumble
- Disabled opponent 2 times using flipper
- No repair and/or replacement parts needed during competition

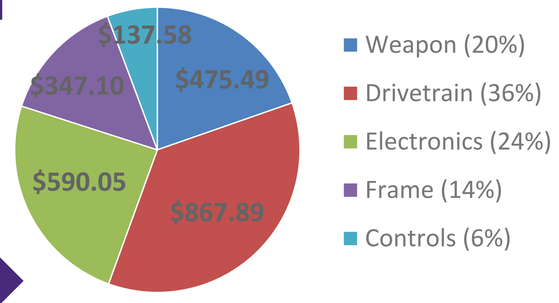
Testing Overview

- Performed 3ft drop tests with robot – Frame integrity held
- Run time testing > 2hr
- Transmitter and receiver testing >500 ft
- Driver testing and driver practice – Decided Andrew Genois would be the driver

Improvements

- Use of 2 joysticks to control robot driving rather than 1
- Larger torque output for drivetrain
- Lower sensitivity of the controller

Budget ($2,500)



Total Spent: $2,418.12

Research & Concept Generation:	Engineering Analysis:	Design Prototype:	Manufacturing & Assembly	Testing:	Combat Practice:	Bengal Bot Brawl:
September - October	October - November	October – December	January - March	February - April	March - April	April 9th

Sponsor: Mr. David Bourg c/o Dr. Nikitopoulos

Adviser: Dr. Moldovan