CARA 2.0 Quadrupedal Robot

Team Name: CARA 2.0
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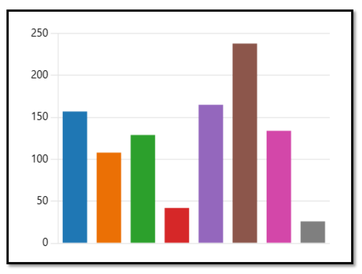
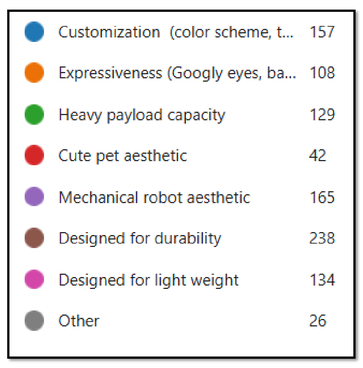
Quadrupedal robots have become increasingly popular as research subjects, industry tools, and consumer products. However, their high cost often limits their accessibility. CARA provides an affordable and easy-to-manufacture quadrupedal robot design that will inspire a budding generation of engineering students, hobbyists, and professionals. Our design leverages 3D printing and off-the-shelf components to empower anyone to build their own quadruped for their own unique application.

Requirements

Engineering and customer requirements were derived from a customer survey.

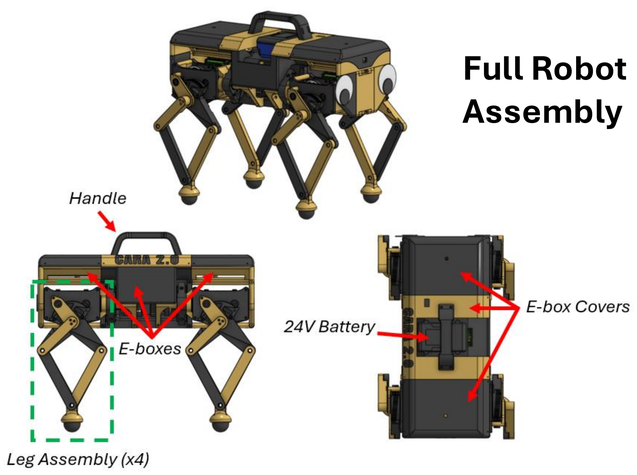




Key Requirements

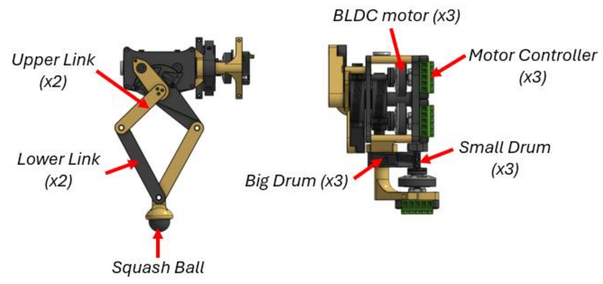
- Low weight (< 20lbs)
- 1 hour battery life
- High mobility (12-DOF)
- Dynamic stability
- Jump height > 3 in
- 10lb payload capacity
- 3D printable structural parts

Design



Full Robot Assembly

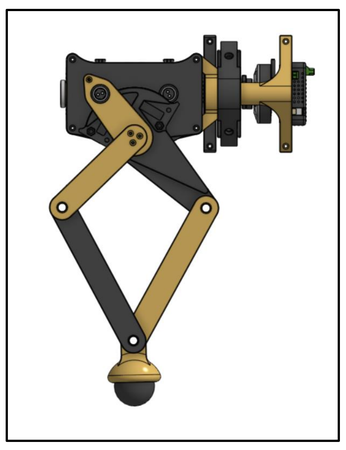
Single Leg Assembly



Key Design Features

Coaxial 5-bar Linkage Leg Design

- Lower loading on the links compared to a "standard" quadruped leg design
- Customizable: lower links are easy to swap out for different applications.
- Aesthetically unique

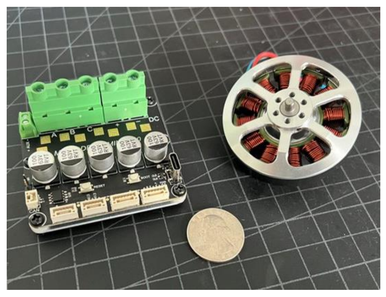


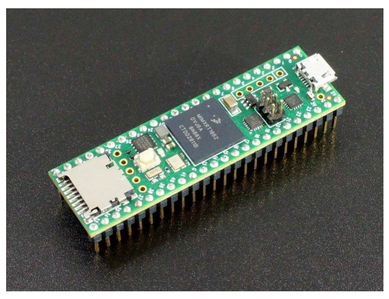
Capstan Drive Speed Reducer

- Rope-driven speed reducer, aka "teethless gears"
- Zero backlash
- Low noise
- High torque transparency
- Low cost

Actuation Hardware

- XDrive Mini FOC controllers and TYI 5008 BLDC motors
- Low cost
- Small size
- High power
- Achieves compliance





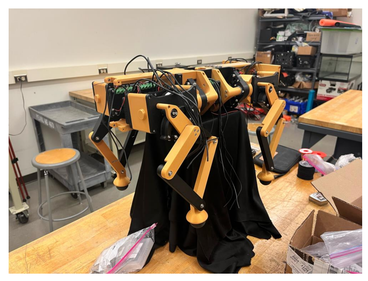
Brain

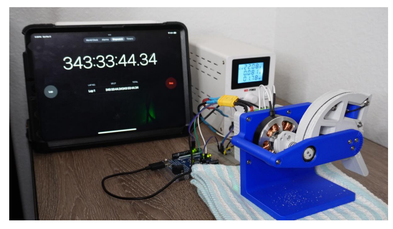
- Teensy 4.1 Microcontroller
- Small size
- Real-time control
- 600 MHz clock speed

Validation and Testing

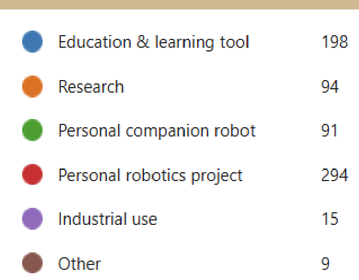
Validation tests were carried out to confirm that our design met our customer and engineering requirements

- Single joint lifetime testing (> 1000 hrs)
- Jump height testing
- Battery life testing
- Mobility testing
- Dynamic stability testing





Value Proposition



Our customer survey shows that there is a demand for affordable quadrupeds amongst educators and hobbyists. The growing industry is projected to increase to $9.4 billion by 2035. A fully assembled CARA 2.0 is projected to sell for $2000, producing $1000 profit, with build kit and open-source options available as well.

Future goals

- Finalize documentation and open-source the design
- Implement reinforcement learning to handle walking and running
- Implement autonomous movement
- Implement add-ons (LiDAR, attachments, etc.)

An affordable quadrupedal robot for engineering students, hobbyists, and professionals