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Engineering

Quadruped Project

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Project Goal



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Design and manufacture a robot capable balancing and maneuvering on four legs

Inspiration



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MIT *Cheetah*

Boston Dynamics *Spot*

Nathan Ferguson's *Dingo*

James Bruton's *OpenDog*

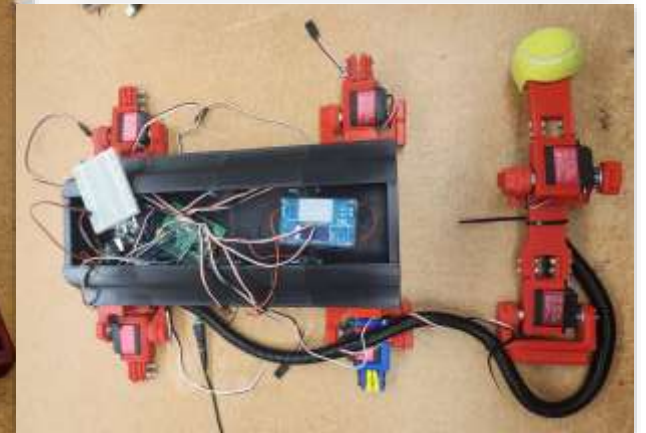
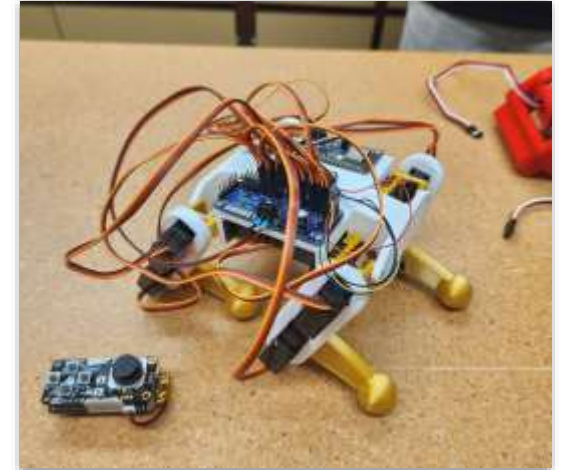


Initial Progress



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- Unpacked original QUAD project
- Ian's Quadruped design
- Calculated motor strengths and max weight
- Created models for V1
- Manufactured part of V1





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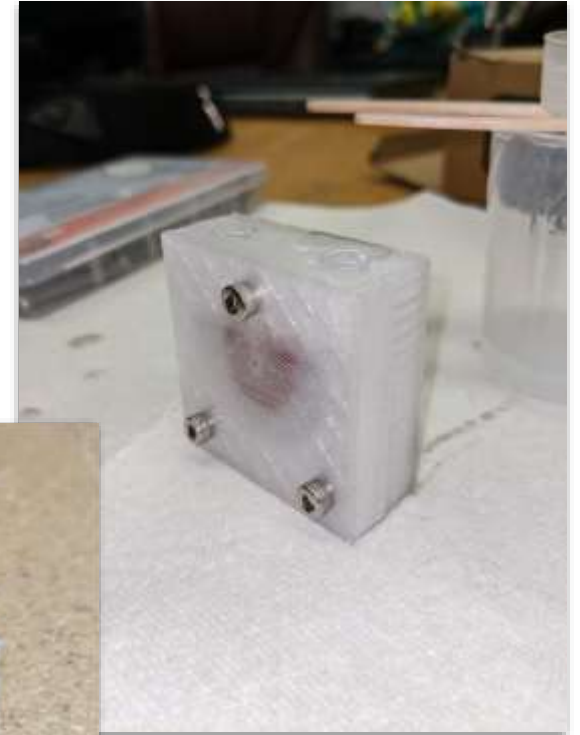
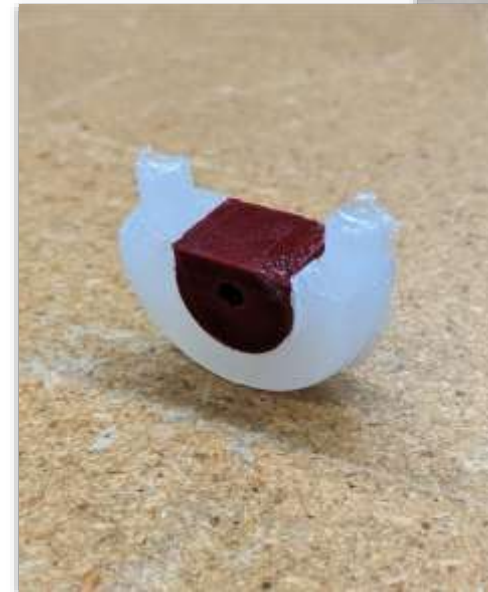
QUAD Version 1

Manufacturing



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- Chassis, Legs, and Shoulders
 - FDM with PETG
- Feet
 - Silicone resin casting (inspired by *OpenDog*)

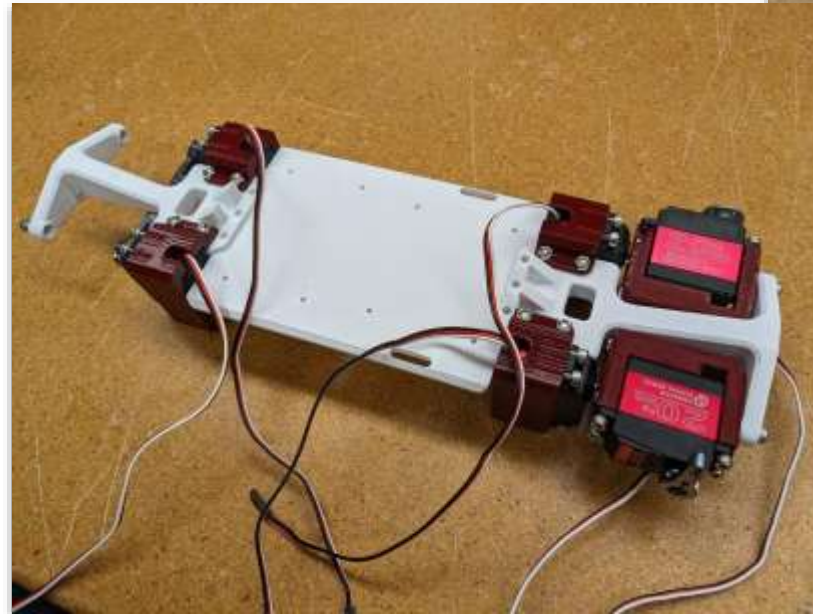


Assembly



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- Leg and Chassis Assembled
- Remaking parts for legs with proper clearance



Gained Understanding



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- Silicone feet work well
- Feet should encapsulate the leg for secure attachment
- Heat-set inserts

Improvements



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- Make silicone resin encapsulate the foot
- Use heat-set inserts
- Add a clearance to 3D-printed parts
- CAD with SolidWorks



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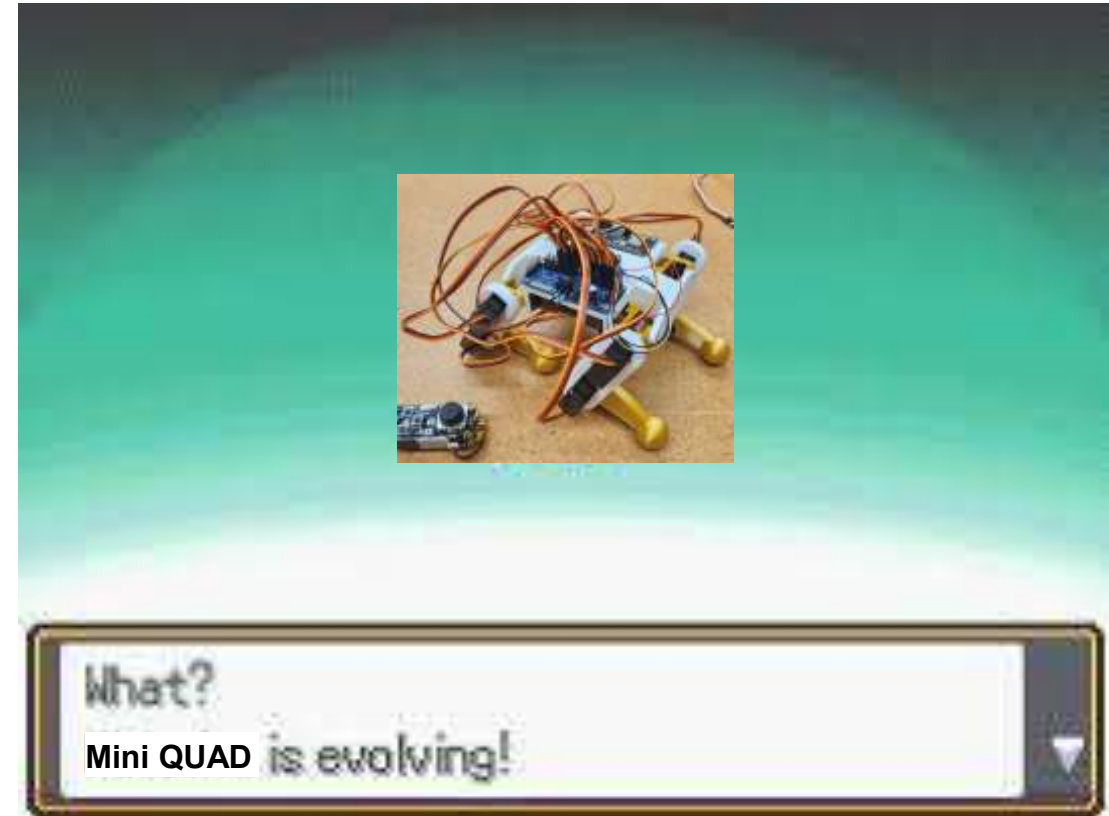
Mini-QUAD

Purpose



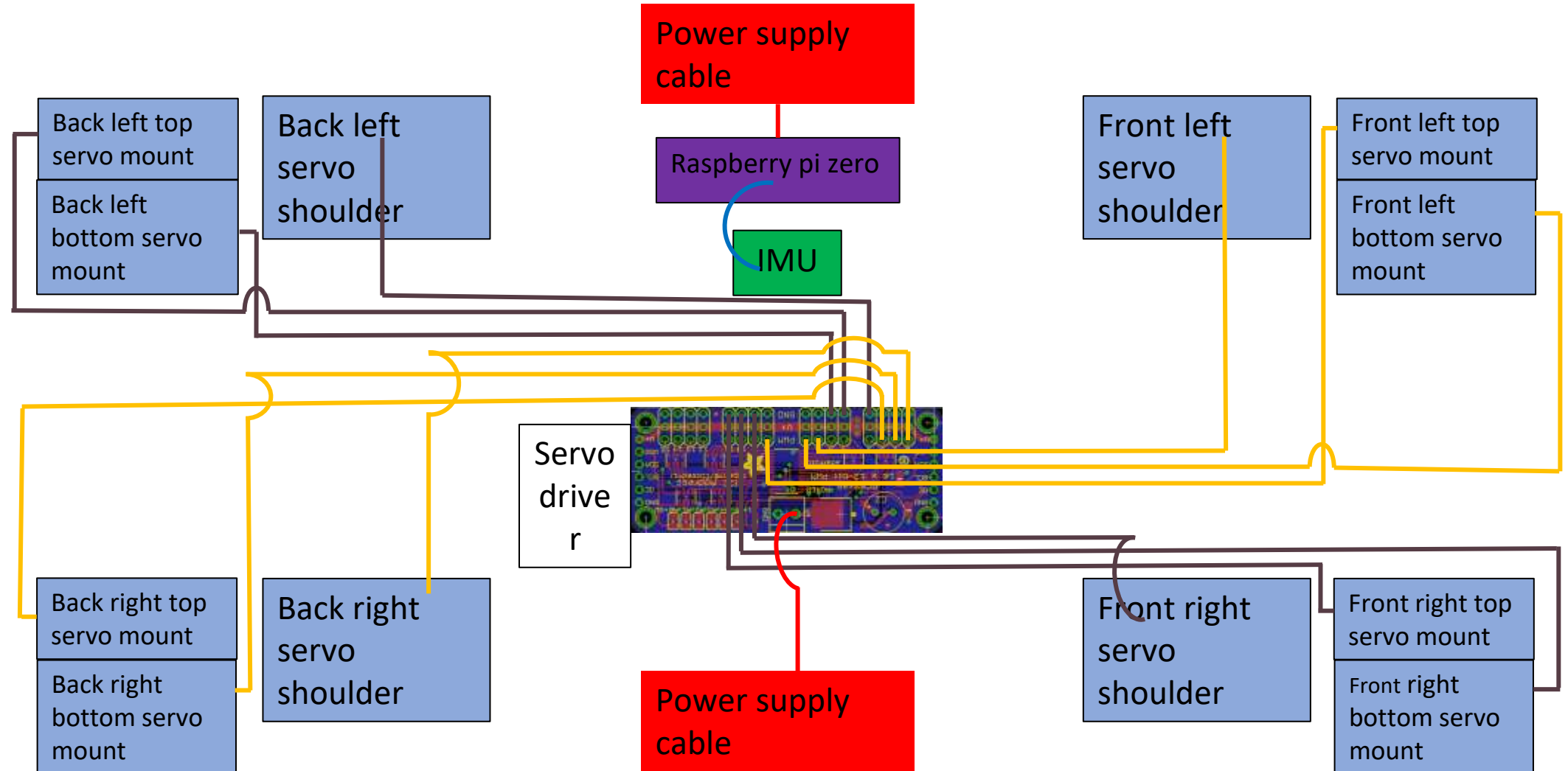
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The purpose of this subteam is to create a miniature version of the original quadruped robot to use as a software platform for future iterations. Will include attempts at lidar & computer vision, model based control, path planning, and much more!



Mini-Quad:

- Must walk on four legs
- Must support twice its weight
- Modular design (designed to evolve)
- Compatible with software for QUAD convoy

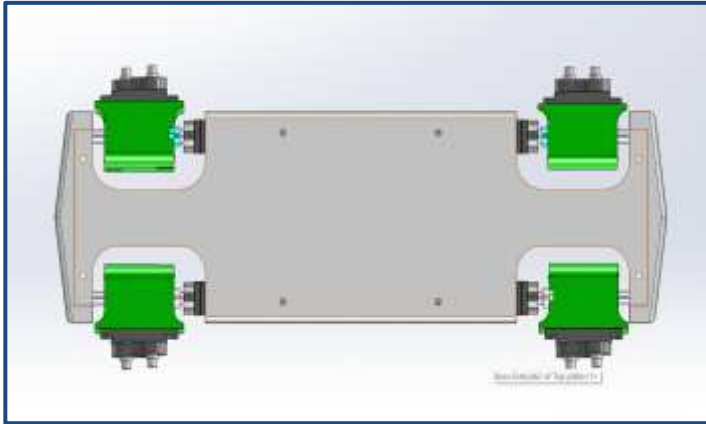


Chassis

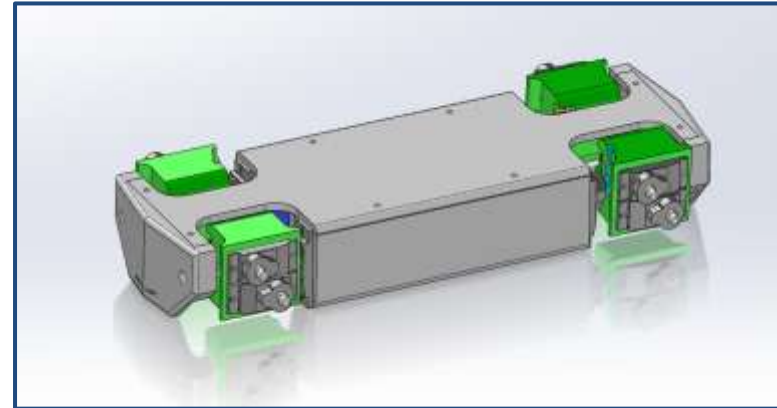


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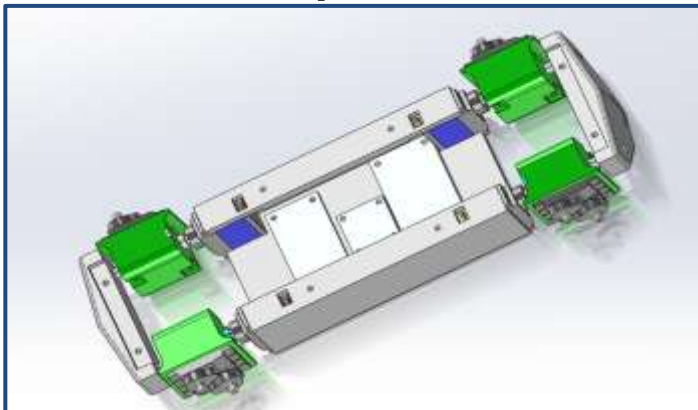
Top View:



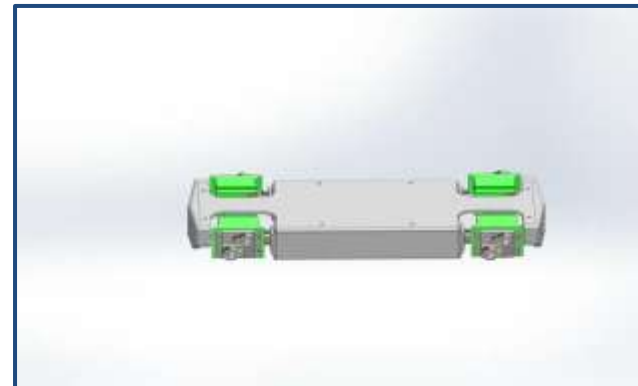
Side View:



Removed Top Plate:



Assembly:



Leg Design



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Mini Quad Leg Pros

- Tendon Drive
- Utilizes the same leg to body ratio as Spot

Mini Quad Leg Cons:

- Non-compliant mechanism.
- No encoders.



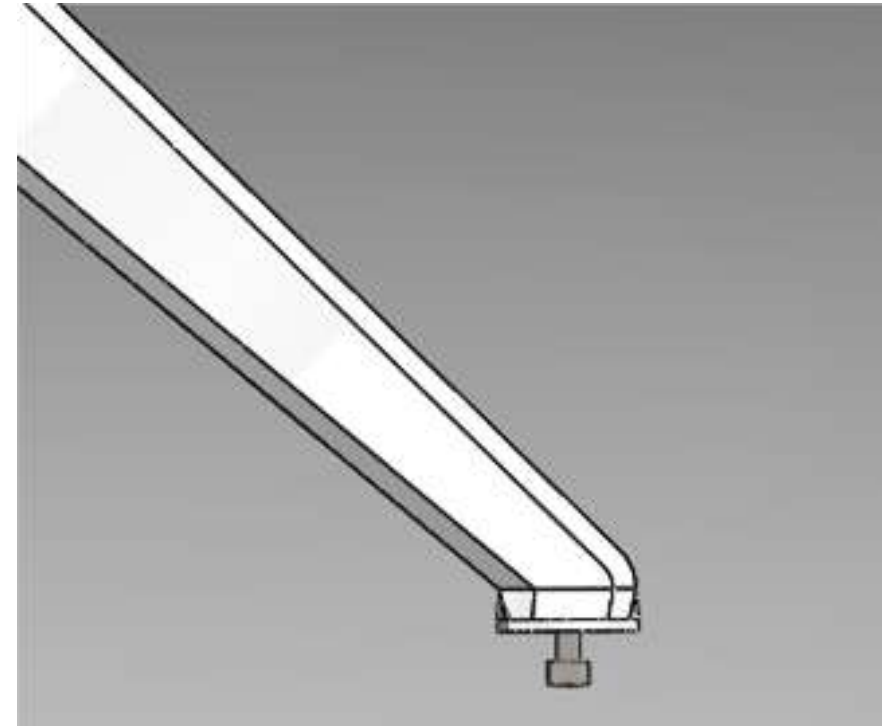
Leg Design - Foot Choice



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Mini Quad Feet:

- Silicone mold “slip-over” shoes. Akin to a swim cap on a head.
- Will either be screw in or slip-on feet. TBD





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Software

Design Requirements

- Control the movement of quadruped from teleoperator inputs
- Must run on each of the quadruped robots
(Compile for and run on Raspberry Pi)
- Be written in a single language (C++)
- Must run OpenCV



- Algorithms ported from Arduino
- Driver written for servo board
- CMake set up
 - Cross-compiles for aarch64 (Raspberry Pi)
- Created access point
- Created script to set up operating system
- Version control on [TURTLE GitHub](#)





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Future Prospects

Future Prospects



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- Completion of QUAD V1 and Mini Quad
- Testing software to drive V1 and Mini
- Payloads
 - Camera & Vision processing
 - Lidar mapping
- QUAD V2

BOSTON DYNAMICS PAYLOADS

SPOT CAM™

Captures spherical images and comes with an optional PTZ camera with 30x optical zoom for detailed inspections.

SPOT CORE™

Provides dedicated processing for applications requiring on-robot computation.

SPOT ARM™

Enables mobile manipulation for tasks like opening doors and grasping objects. (COMING EARLY 2021)

SPOT GXP™

Provides regulated power and an Ethernet port for easy payload integration.





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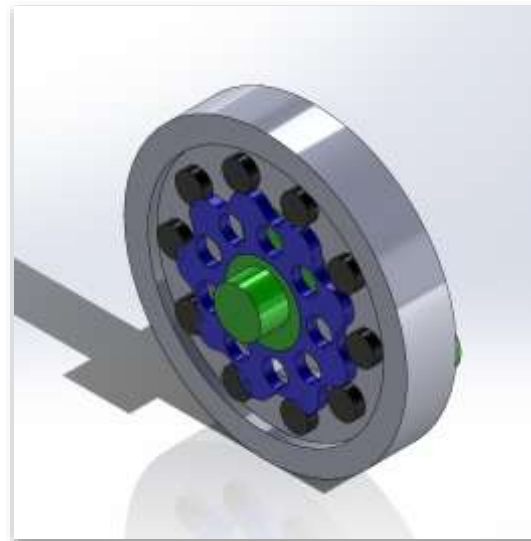
QUAD Version 2

Quad V2 Plans



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- Use experience from designing V1 & Mini
- Stronger (brushless) motors
- Backdrivable cycloidal gearboxes





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Questions