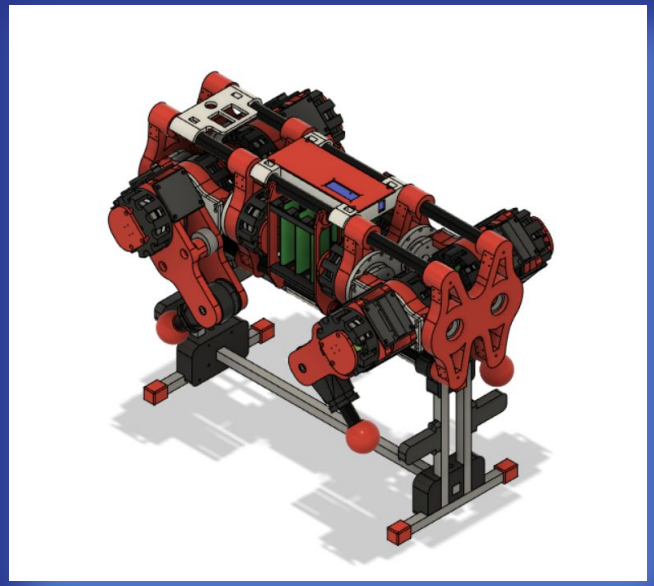
Rambots



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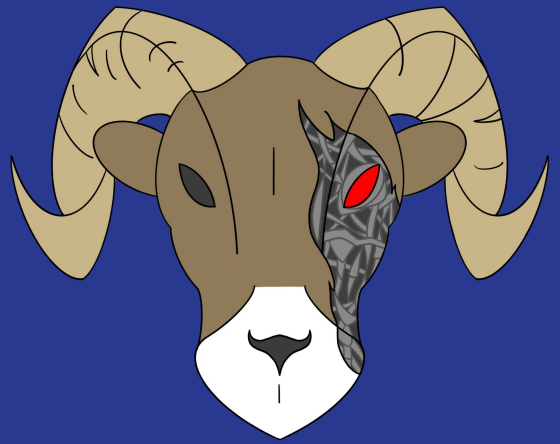


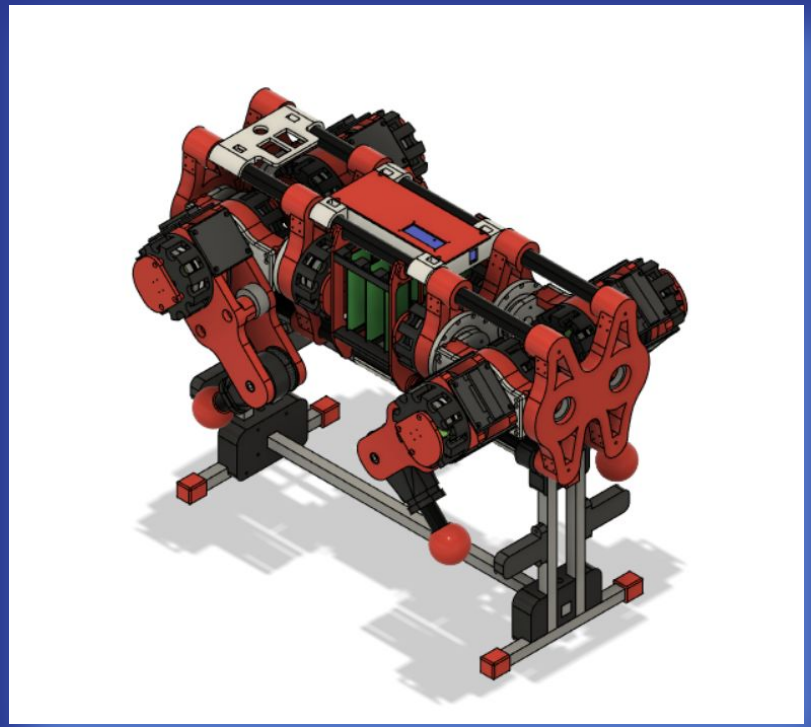
Introduction

Rambots is an open-source project with the goal to inexpensively recreate Boston Dynamics' Spot robot dog.

- Working with ECE Outreach
- Using platform to pioneer guidance and navigation
- Platform will serve future CSU students
- Eventually to serve schools nationwide
- Will be used to inspire future generations of ECE students

https://www.theverge.com/2020/2/19/21144648/boston-dynamics-spot-robot-mass-state-police-trial-issues

Construction of the RamBOT (3D-Model)



- 3D-Model used for this project is called openDogV3 from James Bruton
- openDogV3 is a quadruped 4 legged robot body that can be used to have the robot stand and walk around.
  - Robot has 12 rotational joints.
    - 8 rotational joints for the legs
    - 2 rotational joints for the body
  - Each leg can support 17-25 kgs.
  - The Robot as a whole weighs 20 kgs.
- openDogV3 is used since we lack Mechanical Engineering students to create a model.
- Document the build process with step by step instructions to help others build the open source design.

3D Printing

- Robot consists of 233 parts to be printed:
  - Body: 38 parts
  - Electronics container: 7 parts
  - Leg (4): 43 parts (x4)
  - Odrives container: 16
- Robot Stand consists of 10 parts
- We've been using the I2P Lab
- I2P Lab is unreliable
  - Used by other engineering students
  - Limited printers
  - Specific parts take >20 hrs to print

1. Import .stl file into slicer (Prusa Slic3r)
2. Correct position of part, use a large quality (40mm) for strong 3D printed parts
3. Create G-code, export Gcode onto SD card
4. Import G-code in 3D printer (prusa mark 3), load filament, press start and watch first layer.

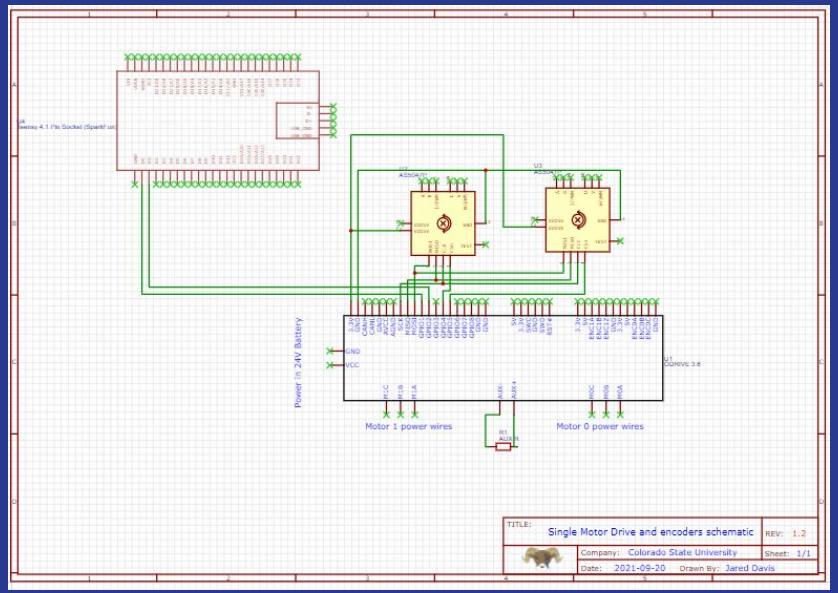
- Outsourcing 3D printing
  - Ty Thourot:
    - Owns a 3D Printer and Design Company with 10 3D Printers.
    - Work with Ty to 3D Print Robot.

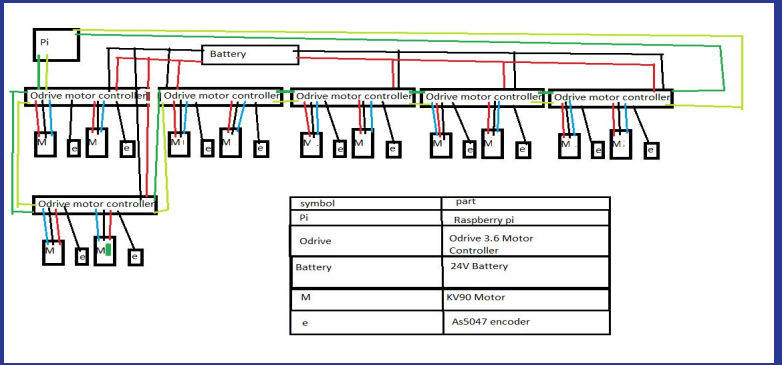
Power Requirements

- 12 motors rated at 90V. According to the documentation the motors draw about 0.5 to 1 amps per each motor at max load.
- The robot is aimed to be about 20 kg
- With the motors rating in mind we aim to have the Robot last about 30 minutes to an hour with a 22.2V 6000mAh Battery.

- Teensy or esp 32 used as the brain, a mpu 6050 for the accelerator, a raspberry pi for machine learning, and a camera for recognition.
- Maximum of 3.4 Amp hours with the raspberry pi.
- 0.4 Amp hours without the Raspberry pi
- 11.1V 2200mAh battery to support the brain functions
- Have not currently implemented the pi yet.
- A larger battery for the brain will be needed

Wiring and Power



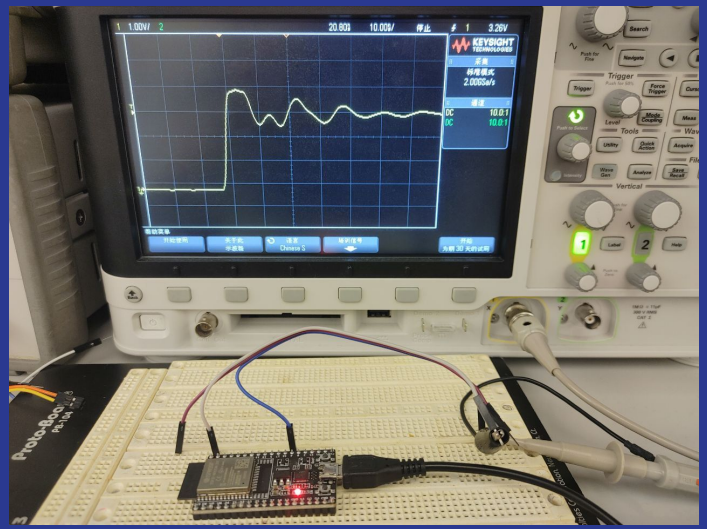


- The Teensy or esp 32 will use its serial ports to connect to 6 Odrive motor controllers.
- Each motor controller connects to 2 motors and 2 encoders.
- The motor controllers are connected directly to the 22.2 Volt battery
- Each encoder will be mounted to the back of each motor for positioning

Embedded Systems slides

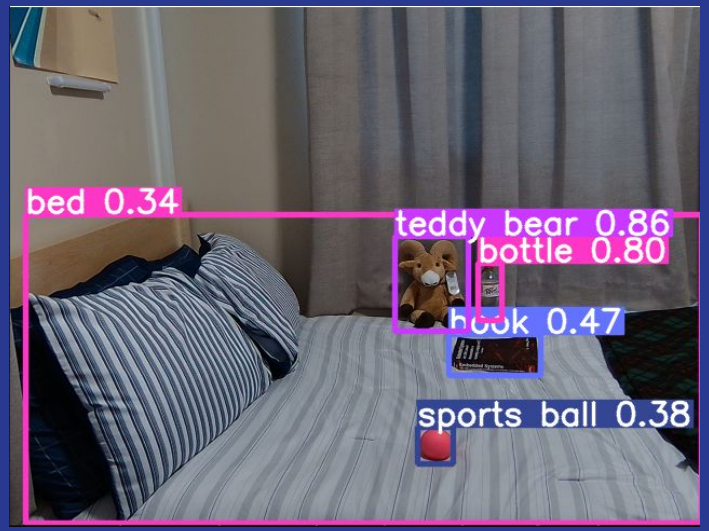
Program Validation on ESP 32:

- $3 Teensy Replacement with an RTOS
- Rust Language -> STD Target -> No Libs
- Non standard setup -> Feature verification



Object Detection on Raspberry Pi 4:

- YOLO with MS COCO
- Hardware Acceleration
- Integration



Roadblocks

- Team was not granted mechanical engineers
- Issues procuring motors
  - Funding availability issues
  - Limited availability of motor design
  - Overseas shipping issues

Solutions

- Used an open-source CAD design for the robot
- Multiple solutions for funding
  - Used multiple P cards
  - Found parts overseas via Aliexpress
  - Prioritized project subsystems that could be completed without the parts

Budget

Initial Budget: $3000
Not including the $1200 member contribution
Total Budget: $20,947

Cost: $4098.47

Total Remaining Budget Shared with Outreach Teams

Summary

Objectives completed this semester:

- Ordered all the necessary parts
- Found sourcing for 3D printing
- Made significant progress in computer vision

Objectives to complete next semester:

- 3D Print Entire Robot in order to start testing electronics, embedded systems, etc.
- Have ML integrated and hardware accelerated
    - Network microcontrollers to Pi