AWS re:Invent

NOV. 29 – DEC. 3, 2021 | LAS VEGAS, NV

DPR203

The AWS DeepRacer open-source robotics showcase

Chris Miller (he/him)
President/Rocket Scientist
Cloud Brigade
AWS Machine Learning Hero

aws

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About Chris Miller

CLOUD BRIGADE

25 years in tech

Lifelong engineer

Enjoys paddleboarding, e-biking, and DeepRacing

AWS DeepRacer Santa Clara Summit Winner 2019

AWS Community Builder 2020

AWS Machine Learning Hero 2021

Crazy idea guy

- Cardboard boat race winner
- Bender costume ($600 in prizes)
  - Servo-controlled eyeballs
  - 40 stereo amplifier
  - MP3 player with Bender voice samples







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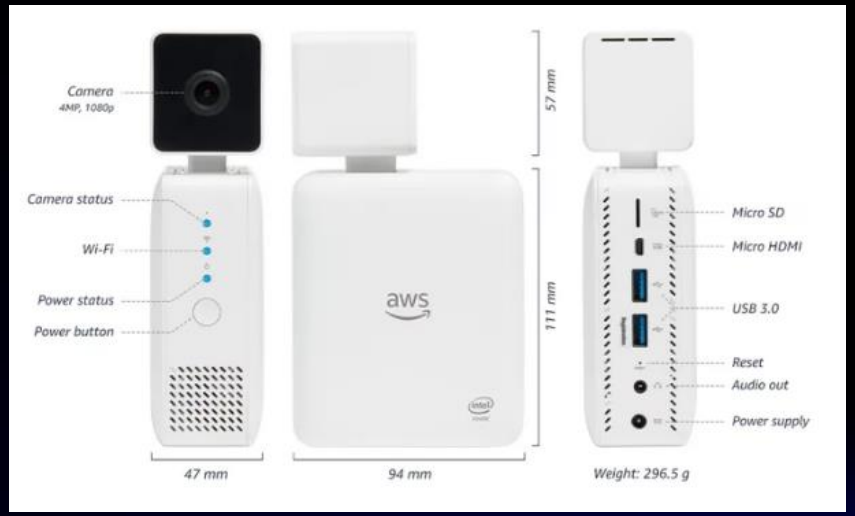
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The Poopinator



https://www.cloudbrigade.com/correcting-bad-behavior-with-ai/

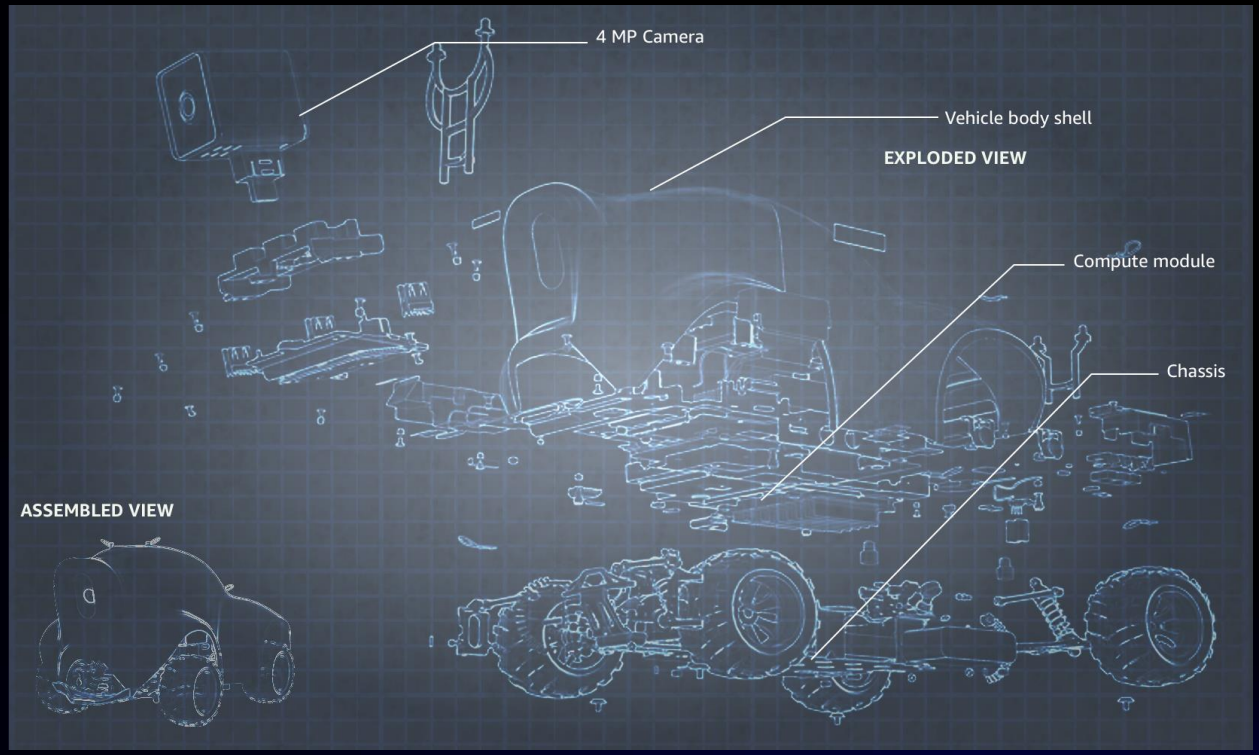




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What is AWS DeepRacer?

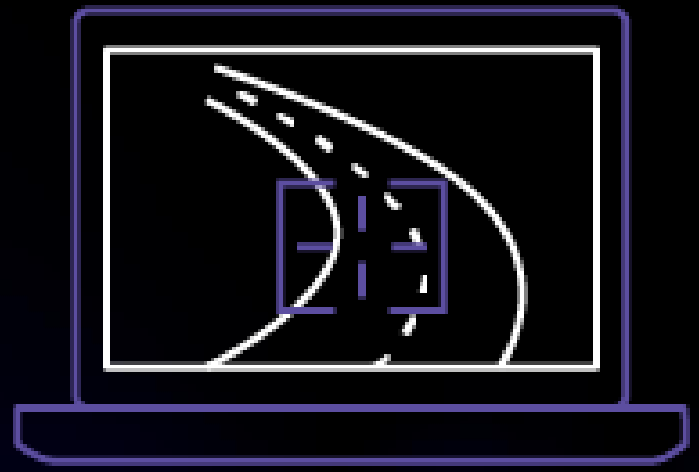
- A 1/18th scale self-driving car
- A 4WD RC truck with a compute node
- A platform to teach ML
- A community-building tool
- A pathway to re:Invent



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What is AWS DeepRacer?

- A virtual environment in the AWS DeepRacer Console
- Abstracts ML model training from Jupyter/Amazon SageMaker
- Based on reinforcement learning
- Uses reward function to learn how to drive
- Virtual racing platform



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What is AWS DeepRacer Open Source?

- Robot Operating System 2 (ROS2)
- A real-time system comprised of software nodes
- Provides interfaces for messages, services, and actions
- Uses a local publish/subscribe system similar to MQTT
- Has a quality-of-service layer for node priority
- A build system



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Navigation

servo_node

ftl_navigation_node

deepracer_offroad_navigation_node

deepracer_navigation_node

model_optimizer_node

Decision

inference_node

qr_detection_node

object_detection_node

Perception

sensor_fusion_node

rplidar_node

imu_filter_node

camera_node

realsense2_camera

Localization & Mapping

rtabmap-ros nodes

robot-localization nodes

Backbone

async_web_server_cpp

web_video_server

ctrl_node

usb_monitor_node

webserver_node

battery_node

software_update_node

status_led_node

device_info_node

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Why AWS DeepRacer Open Source?

- DeepRacer usage was limited to racing
- The car costs money
- Track and barrier is not widely available
- Have to invest to buy/build the track
- 26’ x 17’



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Why AWS DeepRacer Open Source?

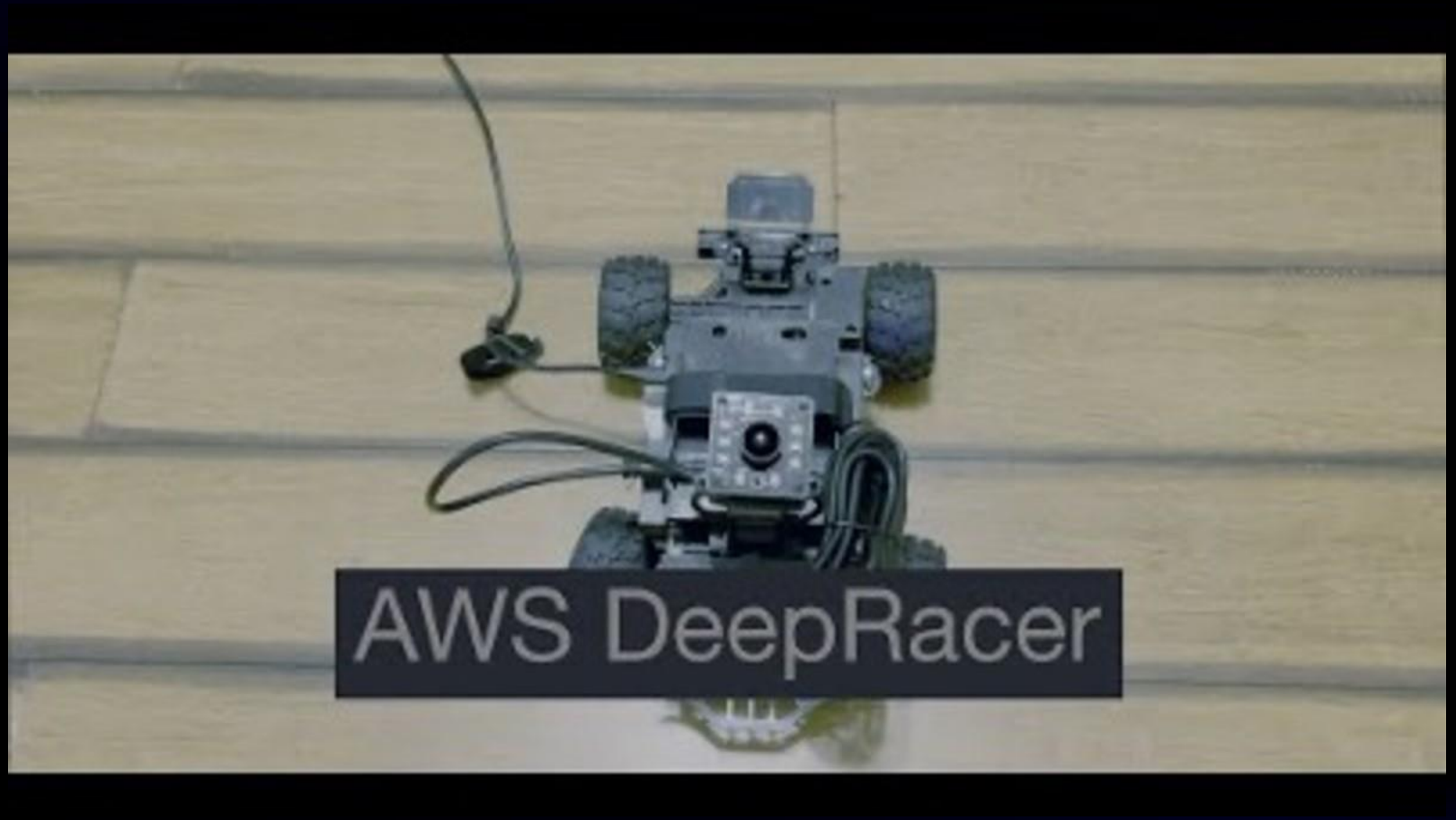
- Racing provided gamification
- The platform is a robot
- Open sourcing allows more use cases
- More creativity
- More learning
- More fun!



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What can you build?

ROBOCAT: A ROBOTIC CAT FOR CAPTURING MICE IN THE DARK BY MARTIN PARADESI



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What can you build?

DEEPDRIVER: AN AUTONOMOUS CAR THAT CAN SAFELY ADAPT TO ROAD SIGNALS AND OBSTACLES BY JOCHEM LUGTENBURG

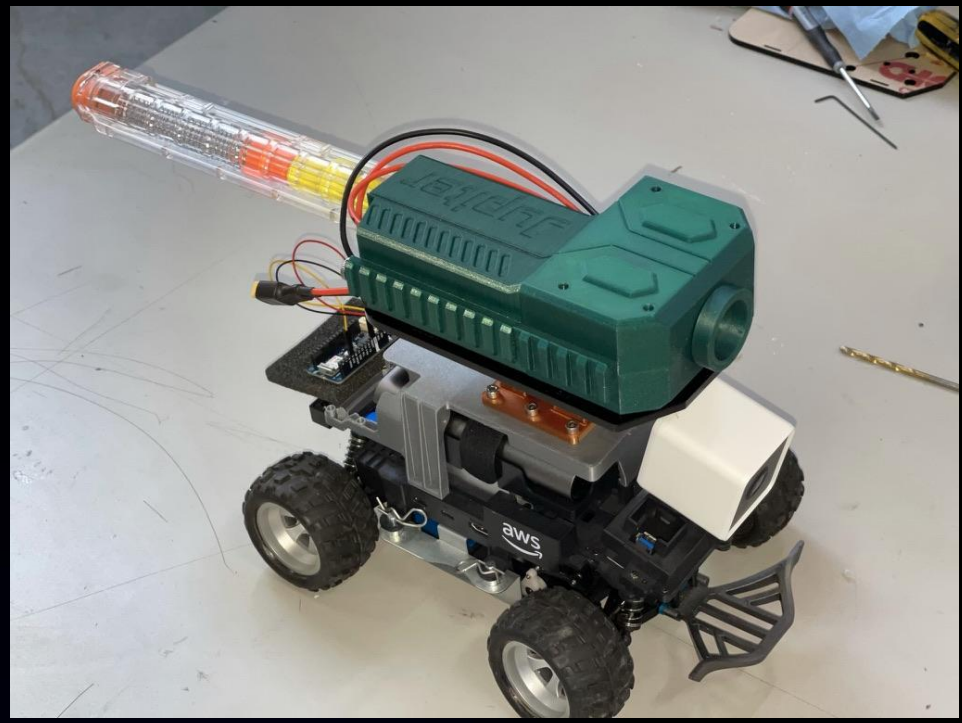


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What is DeepBlaster?

By me, Chris Miller

- Another crazy idea
- Further gamification
- Obstacle course
- More complex competitions
- Platform for other projects



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DeepBlaster baseplate

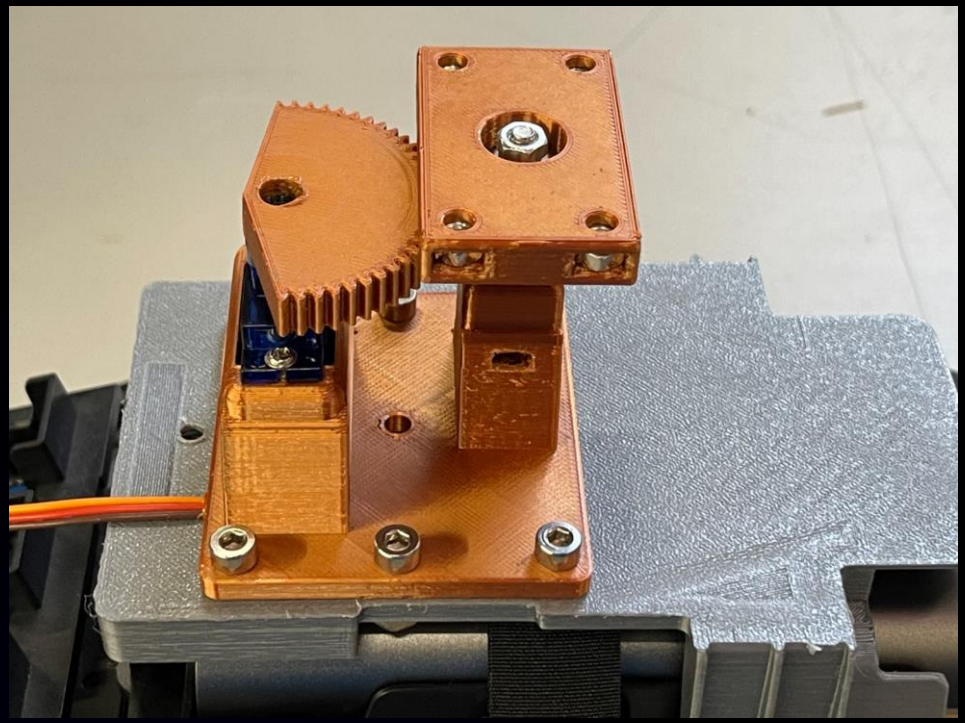
- 3D printed baseplate
- Based on LiDAR bracket



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The turret

- 3D printed tank turret
- Open source from Thingiverse
- Uses micro servo



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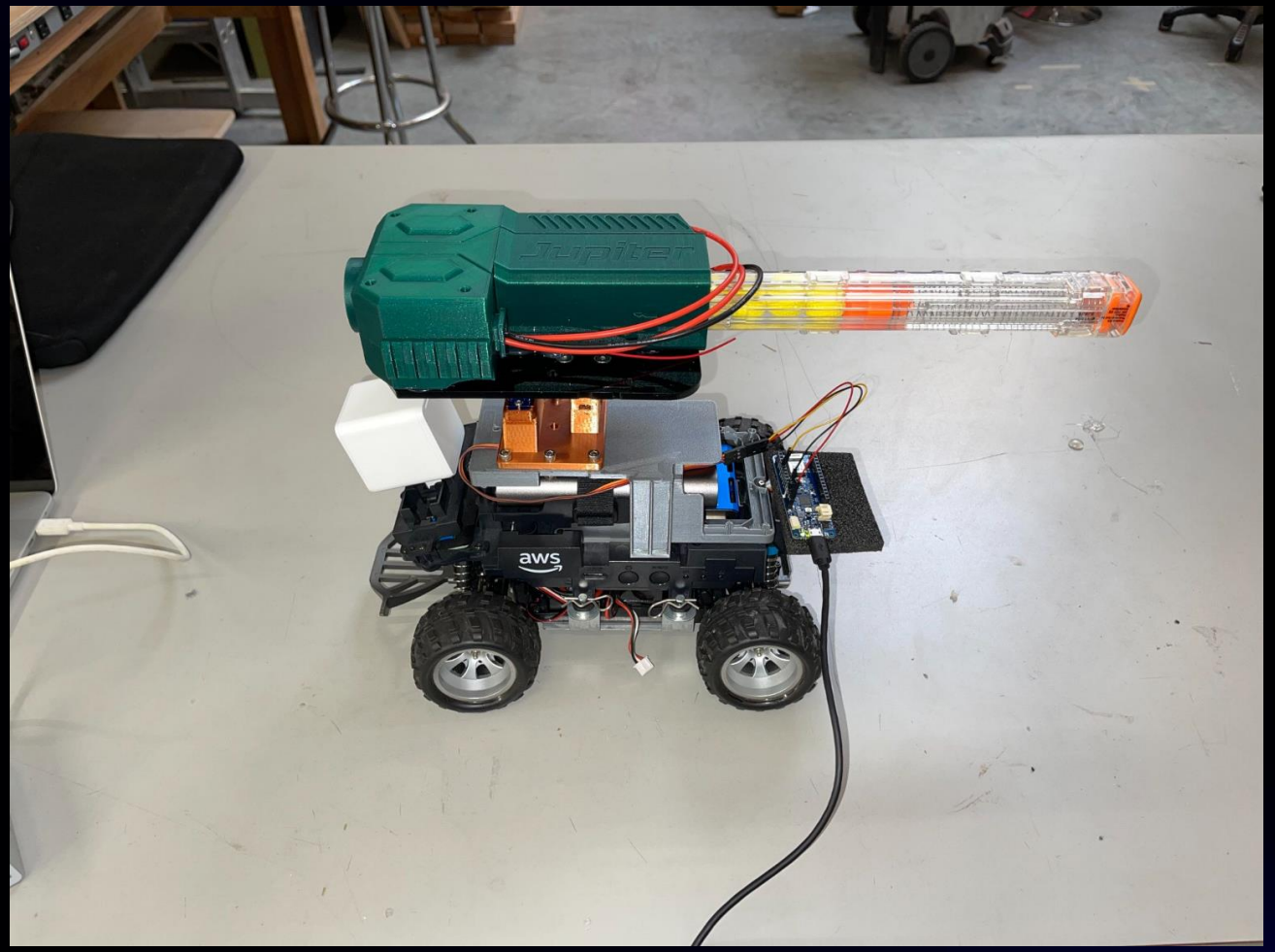
Jupiter Blaster

- 3D printed nerf blaster
- Out of Darts – Luke Goodman
- Full-time business making Nerf mods



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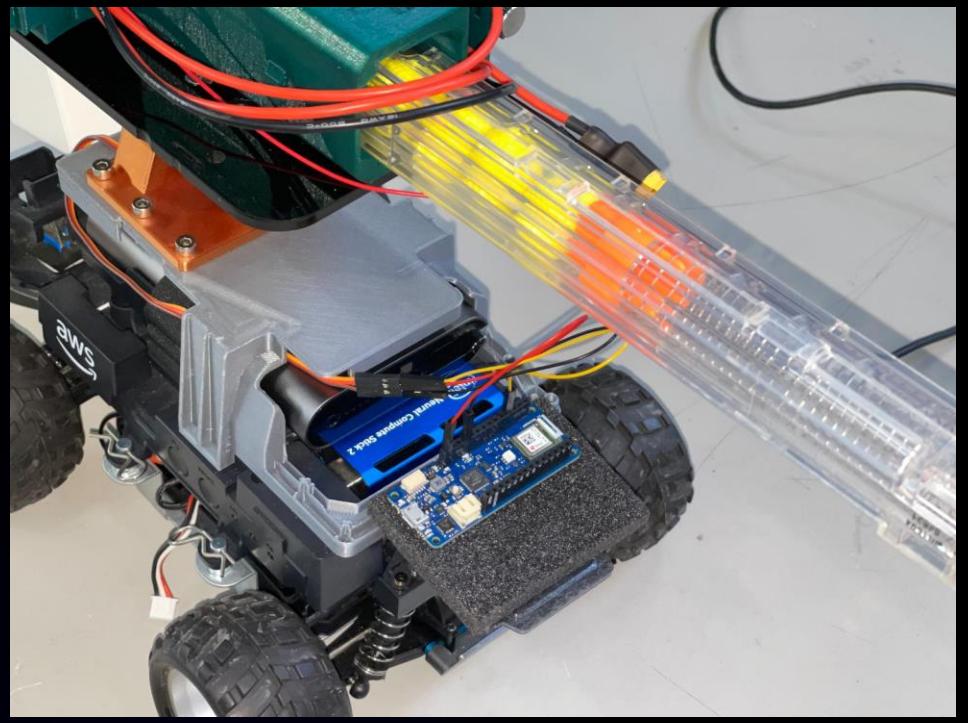
DeepBlaster build



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Blaster control module

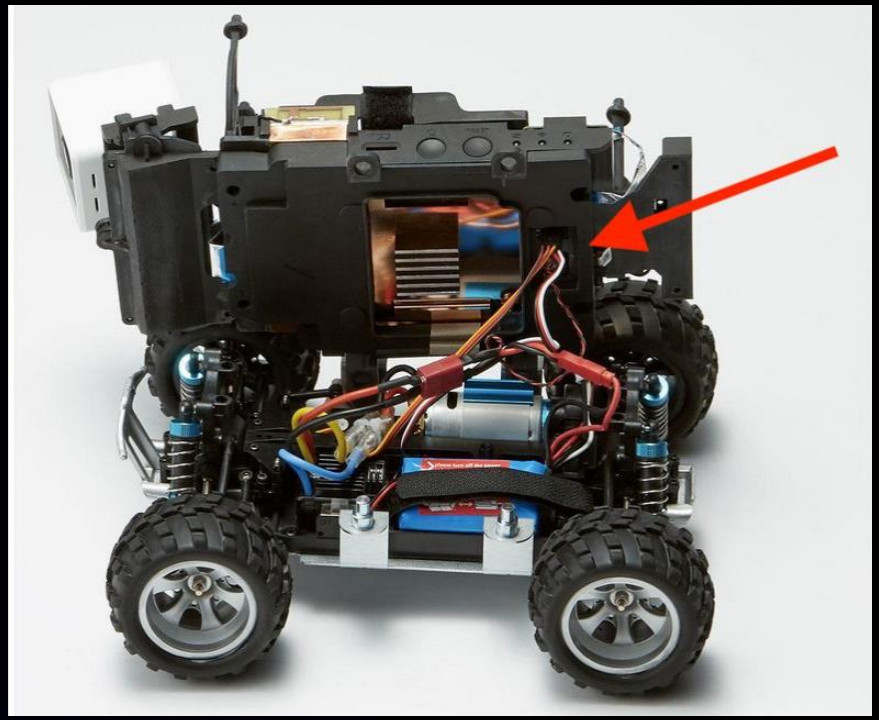
- Blaster controller
- Arduino MKR or Nano
- Extends DeepRacer for robotics
- Intel NCS2



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DeepRacer limitations

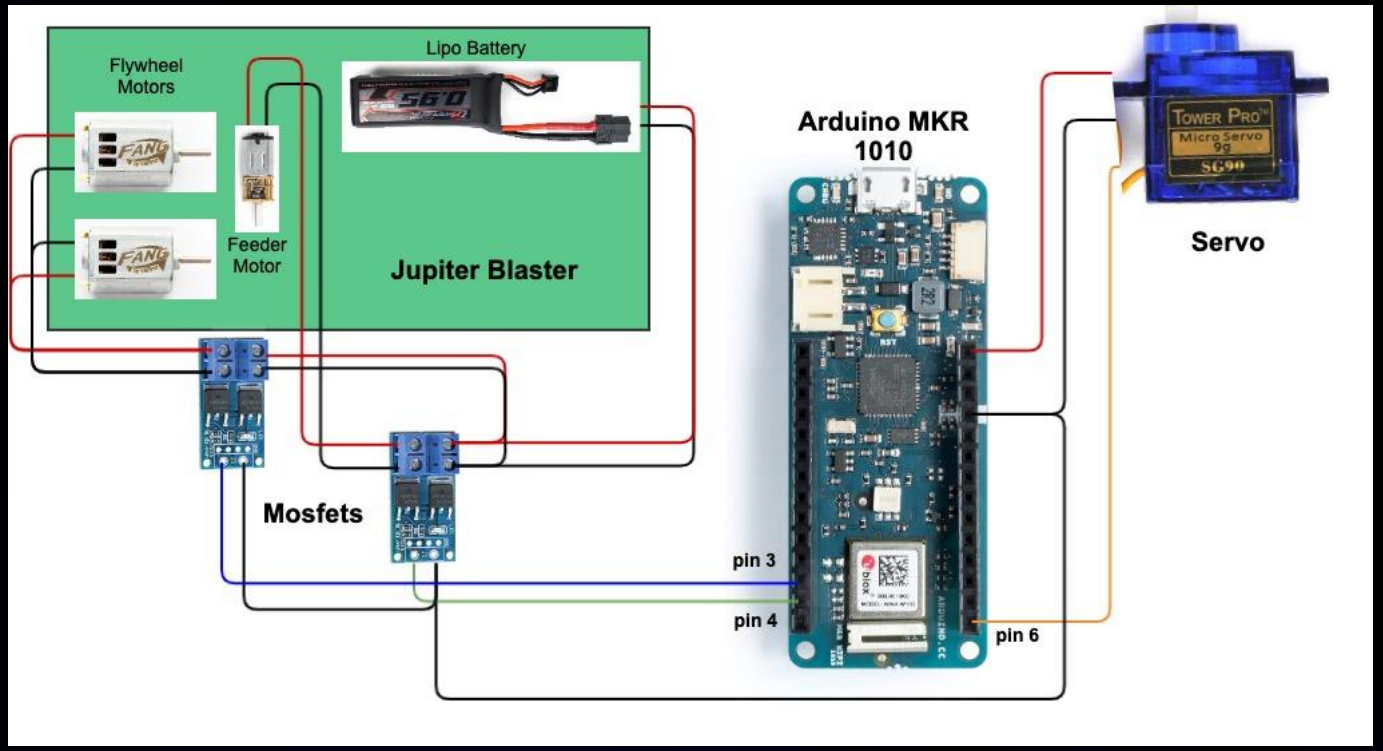
- 5 I/O ports are used
  - Steering servo
  - Throttle
  - LEDs
- 5 USB ports
  - 2x cameras
  - Intel NCS
  - LiDAR
  - DeepBlaster Controller



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DeepBlaster CTRL

- USB serial via UART chip
- 14 digital I/O pins
- 6 PWM capable
- SPI/I2C support for sensors
- Tons of add-ons



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ROS2 project

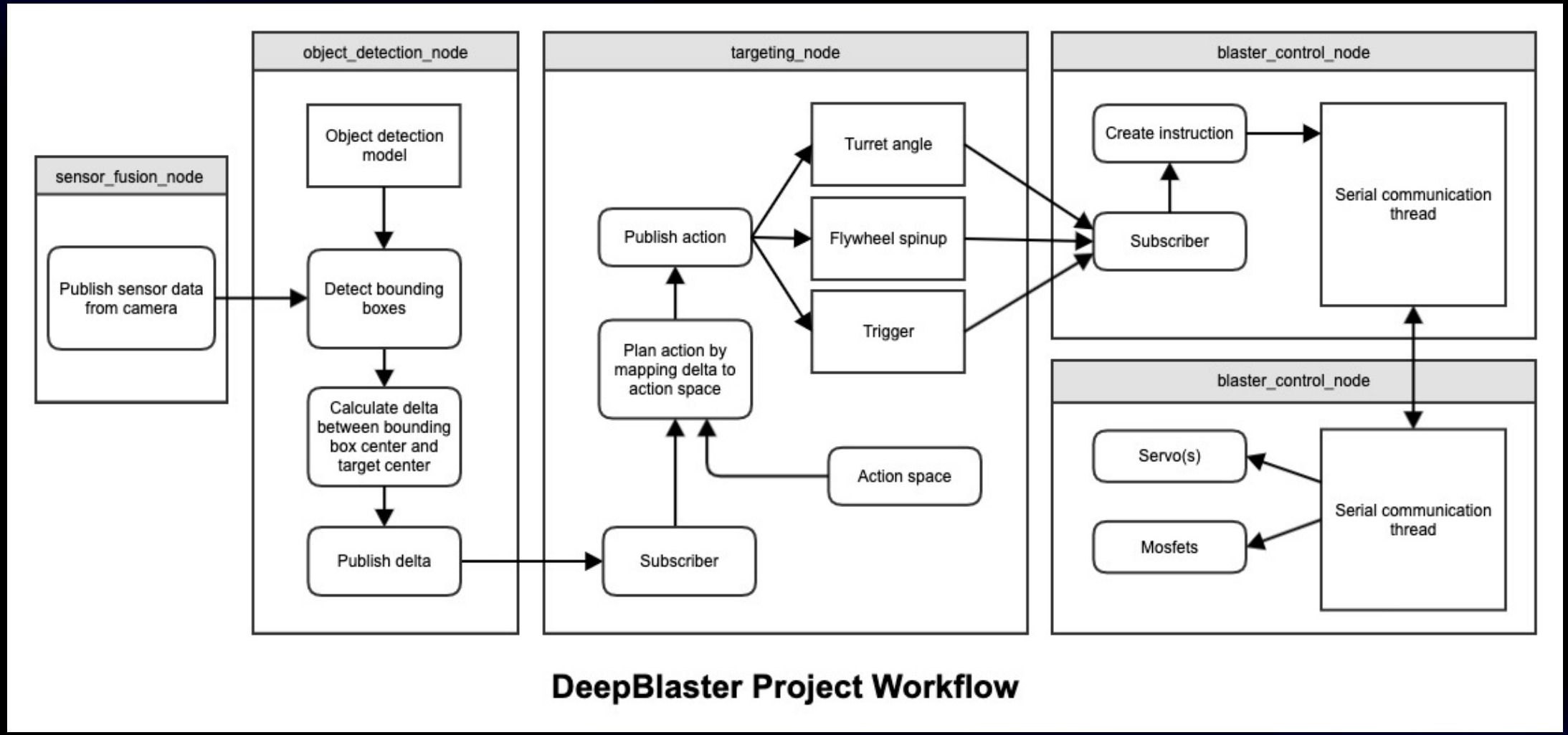
- Based on the Follow the Leader project
- 5 custom ROS packages (nodes)
  - Object detection
  - DeepBlaster targeting
  - DeepBlaster control
  - DeepBlaster interfaces
  - DeepBlaster launcher



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Node workflow



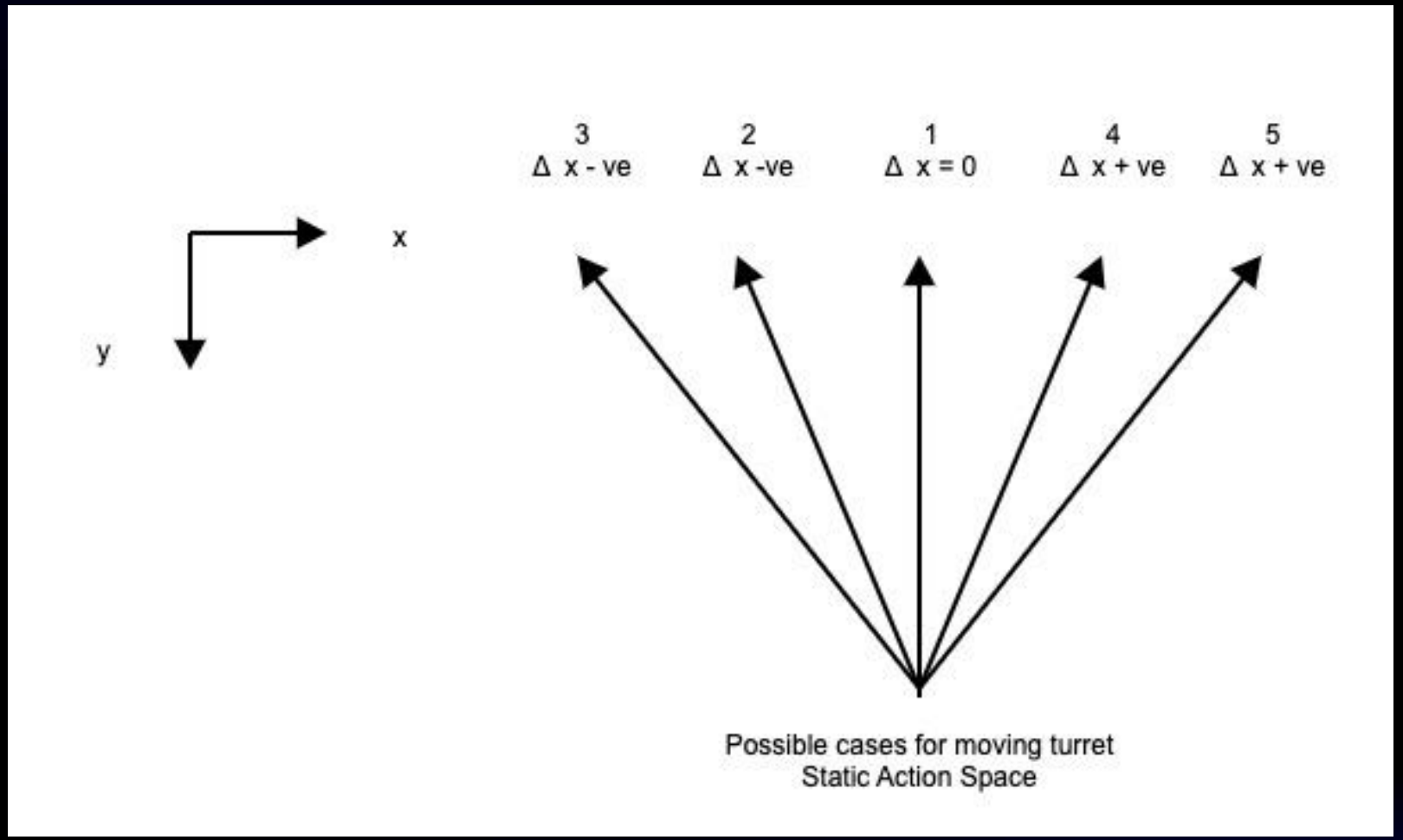
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Action space

Left/Right	Obj Delta	Range [0-1]	Turret Action
45 cm Left	delta_x	0.33	Far Left
15 cm Left	delta_x	0.13	Short Left
0 cm	delta_x	0	No Action/Fire!
15 cm Right	delta_x	0.13	Short Right
45 cm Right	delta_x	0.33	Far Right

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Action space



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Serial communications

- Wi-Fi/Bluetooth is less stable
- No standard protocol
- Fast but not blazing
- Need efficiency and error recovery
- Why reinvent the wheel?
- Robust serial
  - Antonin Raffin
  - Created a robust protocol
  - Up to 255 commands
  - Python and Arduino examples

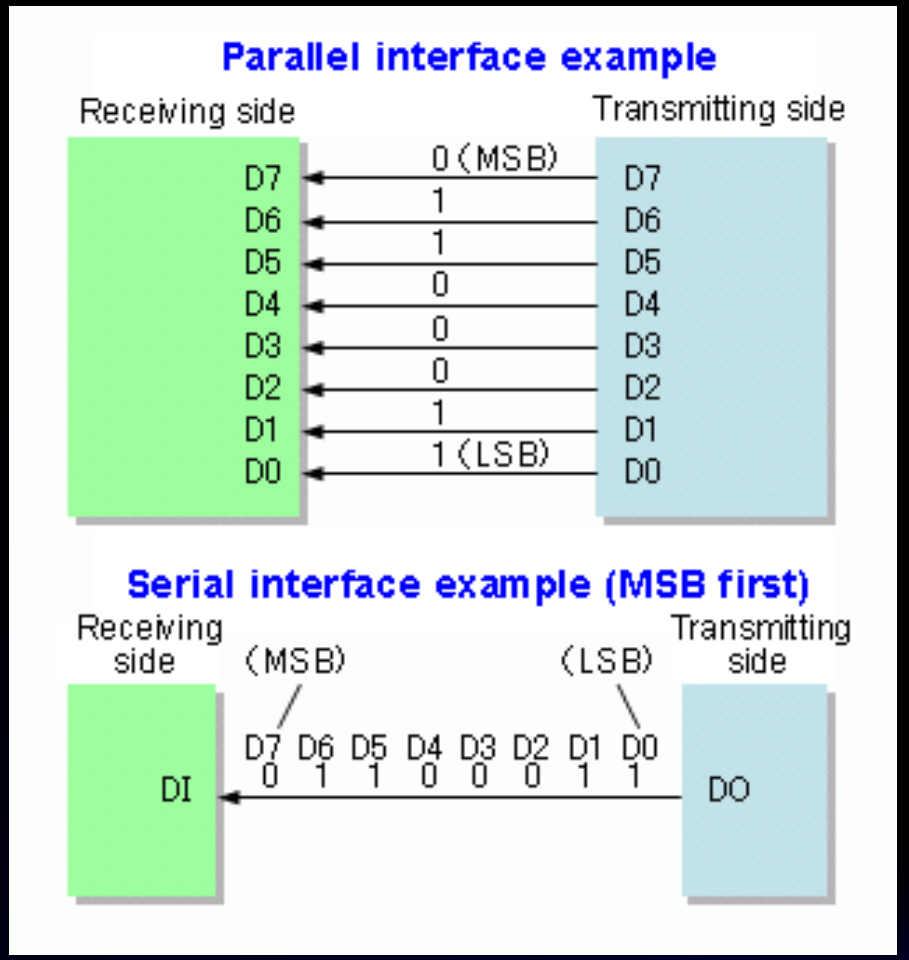
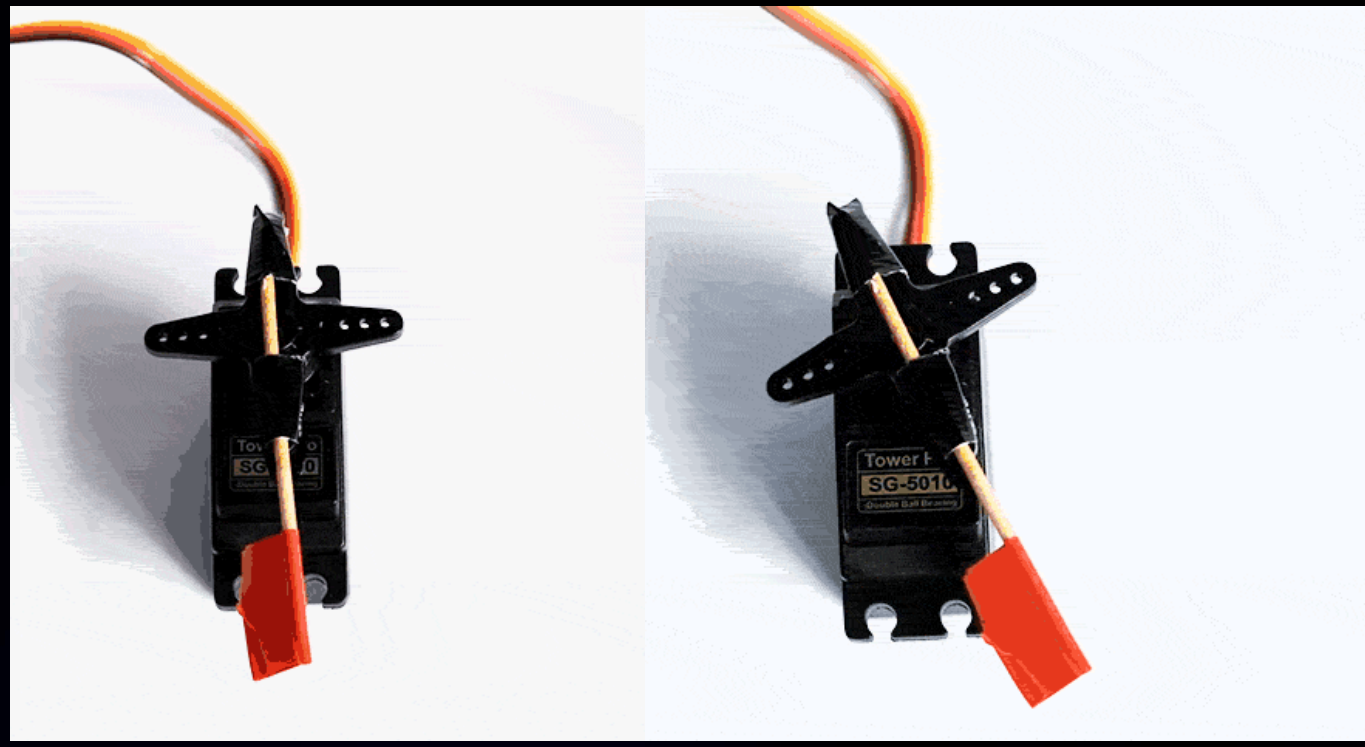


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Precision servo control

- Standard positioning is either
  - Too jerky for video (raw)
  - Too slow (sweep)
- Need the ability to accelerate/decelerate
- Provide just-in-time positioning
- Servo trajectory library
  - Simon Bluett
  - He did the hard math



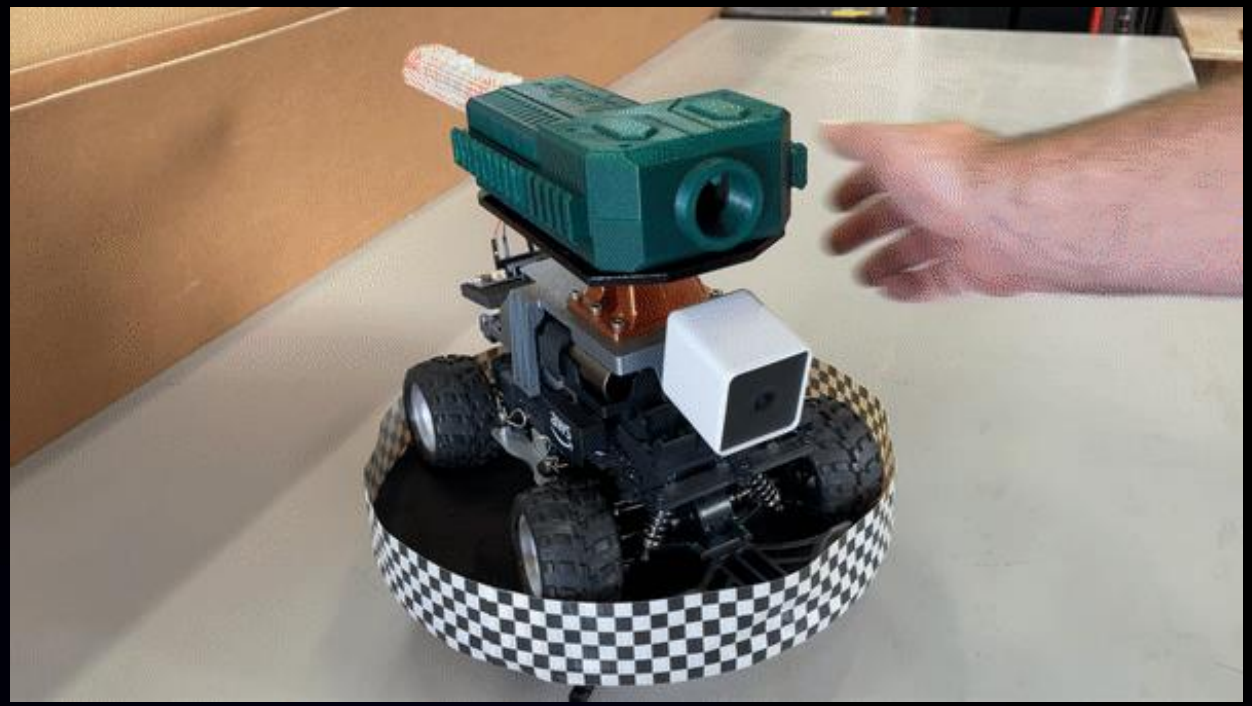
Raw servo positioning

Sweep positioning

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What's next?

- Upgraded DeepBlaster turret
- One-piece design
- Full-sized servo
- Lighter-weight blaster
- Turret-mounted camera
- Dynamic action space
- Hit counter



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Questions?

https://www.cloudbrigade.com/deepblaster/

https://github.com/CloudBrigade

https://www.linkedin.com/in/chris-miller-6470751/

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Thank you!

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