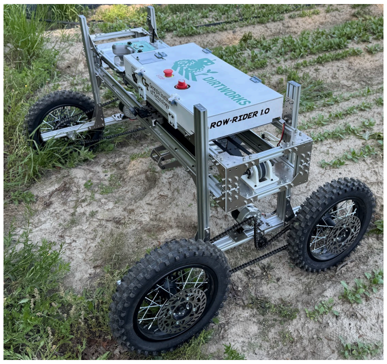
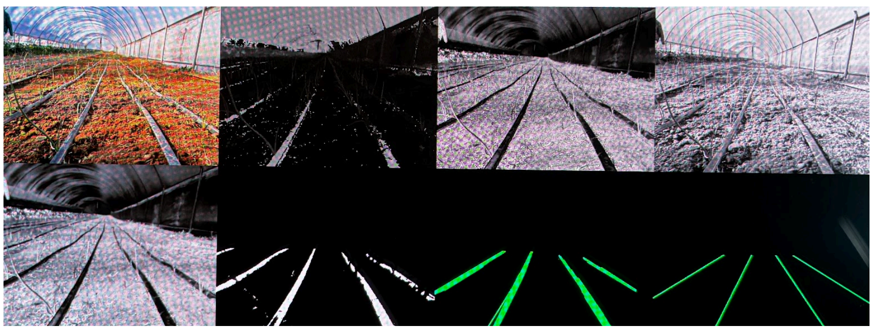
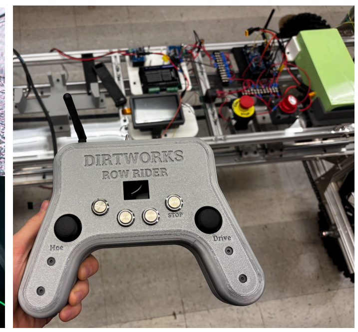
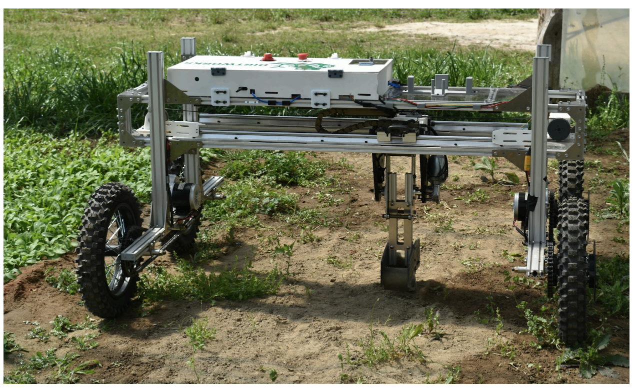
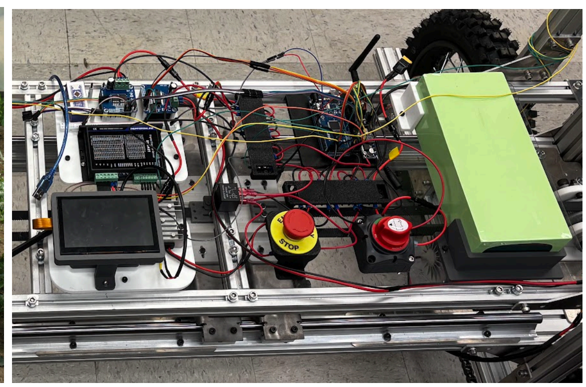
Robotic Weeder: December 2024 - Present

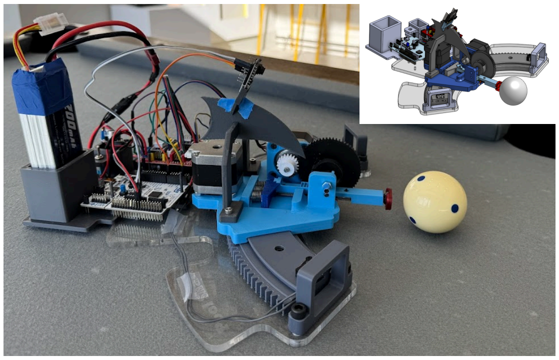
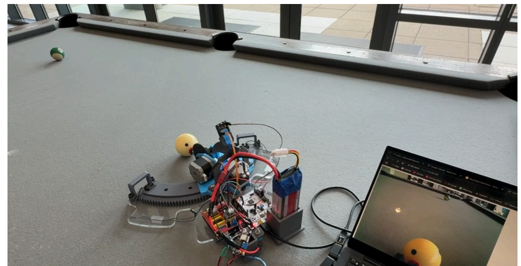
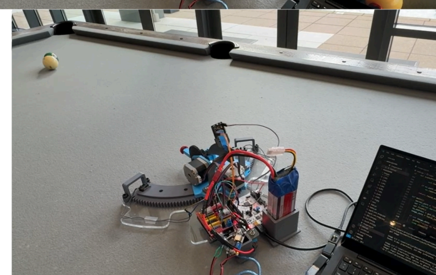
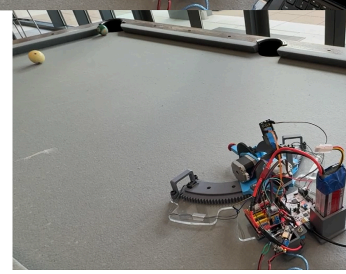
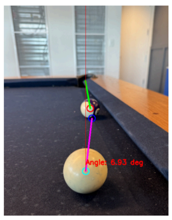
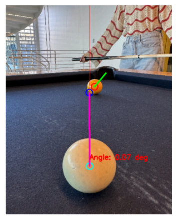
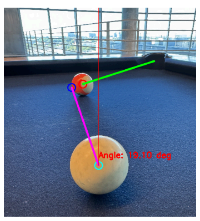
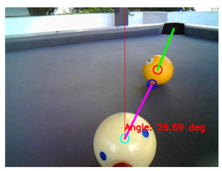


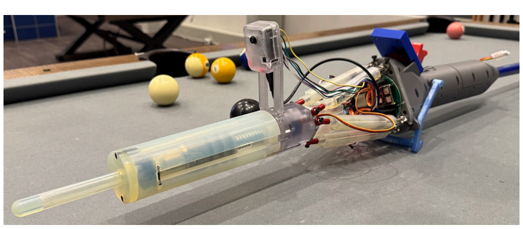
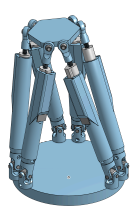
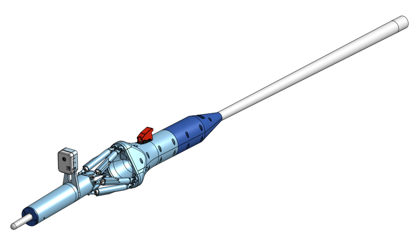



- Building a robotic weeder for small organic farmers to help reduce labor costs and improve quality of produce.
- Frame designed with aluminum extrusion and waterjet plates. Adjustable wheelbase to accommodate for different row widths and bed heights.
- Single axis gantry created with stepper motor and timing belt and rides on linear rails
- Drive uses a 350 W motor with a sprocket to operate with a chain drive and operates with a tank drive. Uses dirt bike wheels and 428 chain for standardization.
- RC controller for communication with the robot
- Control is all done on-robot with a raspberry pi and runs a filtering algorithm to identify drip-tape lines in crop rows. Can navigate autonomously through rows.
- Battery powered and runs for 8 hours and the robot operates at 3 mph which results in 3 acres/charge.
- Weeder attachment uses a stirrup hoe mechanism to mimic what farmers currently use. Suspension built into the weeder mechanism to ensure constant pressure. Weeder attachment stows upwards when not needed.
- Awarded 1st in Mechanical Engineering at Georgia Tech Spring 2025 Capstone Expo

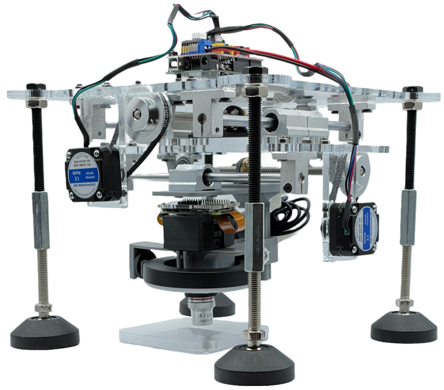
Pool Shooting Robot: Fall 2024-Present

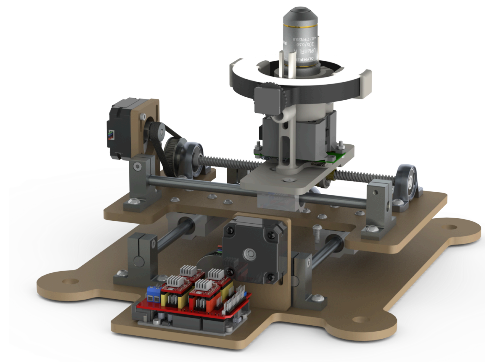









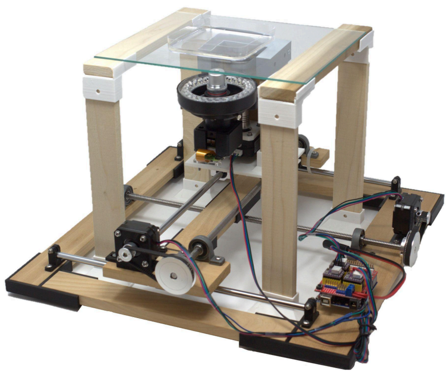
- Created a robot to automatically make pool (billiards) cut shots for fun
- Actuation system involved a 3D printed curved linear rail with corresponding carriage with a stepper motor turning a pinion along a curved rack on the rail. Experimented with various fits to optimize for 3D printing tolerances.
- Shooting mechanism uses four springs, providing a total force of 100 N. The springs are removable allowing for variable force. A rack and pinion with a ratchet is used to push back the springs along a metal linear rail with a linear slide.
- To acquire the image I used an ESP-32 camera module that sends the image to my laptop over wifi.
- To figure out the angle for the shot I used object detection to find where the pocket and balls were. I gathered data of 500 images, labeled, and trained my own YOLOv11 computer vision model with 99% accuracy. Successfully made several shots with the system (~80% accuracy).
- Now developing V2 of the design that is self-contained on a pool stick. Custom linear actuators for a stewart platform and CAM mechanized spring loaded shot.

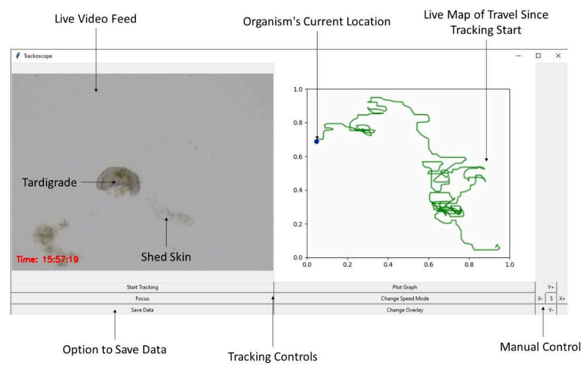




Trackoscope: 2019-2024



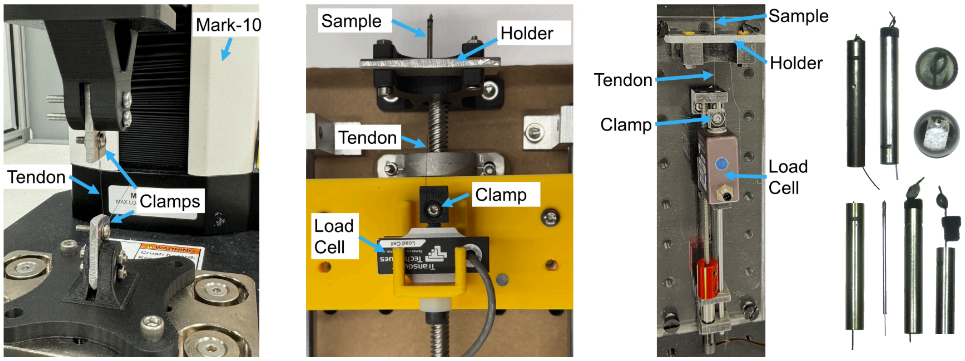






- Developed custom low-cost tracking microscope ($300) to autonomously follow organisms at microscopic resolution at the Bhamla Lab at Georgia Tech.
- Went through 6 different design iterations. The latest iteration is designed for scalability and manufacturability (top images are the latest prototype)
- Used an Arduino, stepper motors, and a low cost linear rail stage for the hardware to control the two axis actuator. Achieved variable precise motion ranging from 140 microns/second to 4600 microns/second.
- Experimented with various gantry systems and worked through binding issues with linear rails.
- Developed custom optics to digitally record organisms at various magnifications.
- Used Python and OpenCV to follow the organism autonomously using object tracking. Built a custom GUI for visualizing the tracking.
- Used Solidworks to design the microscope and used methods such as 3D printing, laser cutting, woodworking, soldering, and water-jetting in the construction process.
- Successfully tracked multiple fast-moving microorganisms for long durations.
- Extracted and analyzed key organism data such as area covered and velocities. Used machine learning powered tools to extract pose data in complex organisms.
- https://doi.org/10.1371/journal.pone.0306700 - First author, peer-reviewed

Tendon Driven Guidewires: 2023-2024



- In the RoboMed Lab under Dr. Nancy Deaton I developed a method of attaching both tungsten and nitinol tendons to stainless steel guidewire and endoscopic robots.
- To secure the tendon to the end of the tube, I devised a method that used various knot tying methods, reinforced the knot with epoxy, and used micro plates created by a femtosecond laser to support the knot. Using this method, the robots were able to sustain pulling forces 2x those needed to obtain full curvature.
- Wrote a tutorial paper (second-author) detailing existing methods used in research and industry as well as outlined the procedure to replicate my method. Conducted 60+ pull tests with various configurations (setups seen on right) to compare the various factors; verified results with implementation in an endoscopic robot and observed attained curvature. (https://link.springer.com/article/10.1007/s41745-024-00455-3)

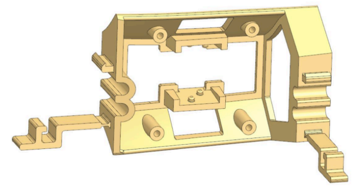
SpaceX Intern Project: Summer 2024

- Worked on the Starlink dish design team as a responsible engineer intern
- Tasked with automating the transfer of the dish between the construction and packing lines which involved flipping and rotating the dish. Also operates for more than 5 million cycles with a desired throughput of 2000 units/hour.
- Went through two design iterations within the span of 3 months with a final implementation running at 2000 units/hour on the line with zero failures in 50,000 units.
- The main system involved 4 pneumatic actuators: 2 large pushers to move the system up and down, 1 rotating actuator to flip the dish, and 1 parallel grabber. I also high-speed YZ gantry with a vacuum end effector to move the flipped dish between the two lines.
- Worked through issues with binding and stability with the high-speed pneumatics.

Tesla Intern Project: Spring 2024

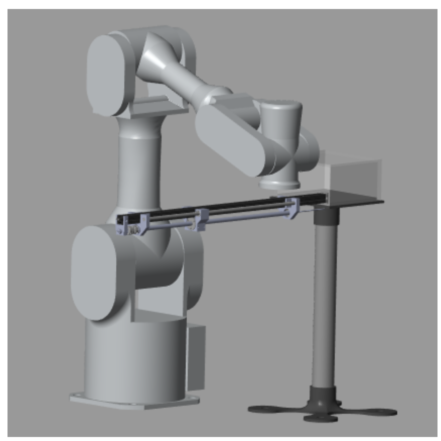
- Worked on the geartrain development team as a mechanical engineering intern
- Designed a robotic and automated system of capturing image data of rotors and stators during the development phase of a new drivetrain to document the states of the components to aid in the help of finding the root cause during debugging.
- The system takes 30 seconds to scan and upload 4k resolution images of the stator and rotor to a web server I set up for the team. Recorded data for 50+ components at the time of my departure.
- Designed housing for a new differential and did material testing for strength based on given loads.

Zipline Intern Project: Summer 2023



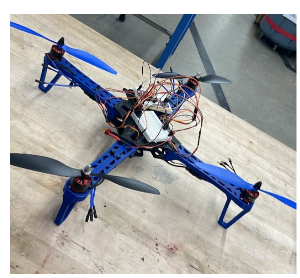
- Worked on the mechanical avionics team to design mechanical components for the electricals on the drone.
- Designed 18 unique injection molded parts that live on the platform 2 drone and secure the busbars and other electronic components.
- Worked with various stakeholders to identify engineering requirements and held multiple design reviews to go through iterations. Engineering requirements designed for include weight reduction, high temperatures, electrical safety, flight loads/vibrations, space restrictions, and cost.
- Made preliminary designs for 5 assembly fixtures to optimize assembly time.
- Used NX for CAD, Python for load analysis, Mark-10 for prototype testing, and laser cutting/3D printing for prototyping.

6-DOF Arm Simulation: Spring 2023



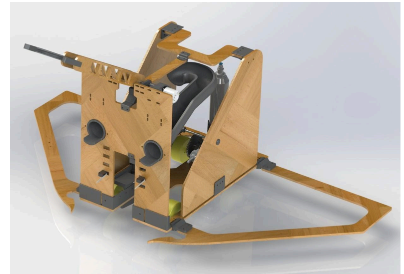
- Simulated the path of a Mitsubishi PA-10C 6-DOF robotic arm for neuroendoscopy point of entry
- Used inverse kinematics to derive motions for the arm in MATLAB and ran simulations to ensure collision avoidance
- Implemented in real-life with simulating multiple paths with a hydrogel brain

Custom Drone and Flight Controller: 2022



- Developed a low cost drone ($300)
- Constructed and programmed a custom flight controller using ESP-8266 WiFi Module
- 3D printed mounts, frame, and accessories for the drone
- Attached a FPV camera and used object tracking to automate landing and flying to locations

ME 2110 Robot: 2022

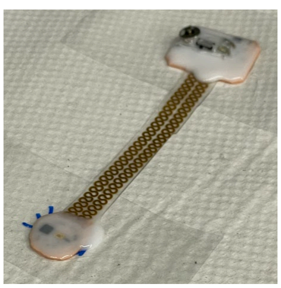
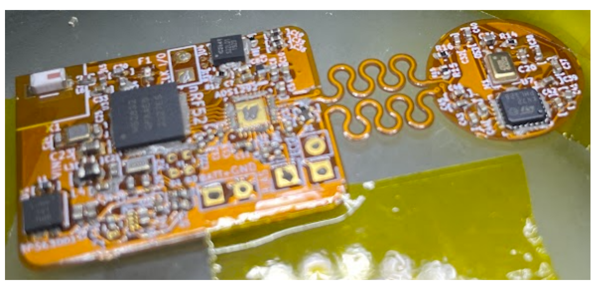
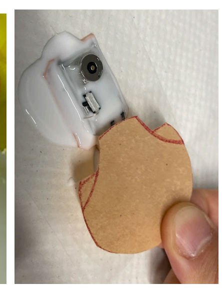


- Developed a robot for the ME 2110 class to complete several tasks in a limited amount of time
- 3D printed mounts and laser cutted parts of robot for construction
- Programmed robot in Arduino IDE to run autonomously and complete the set tasks
- Worked with limited actuators and developed passive launch systems

Boston Scientific Intern Project: Summer 2022

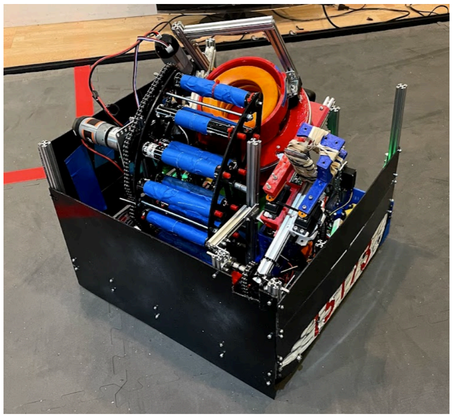
- Improved one specific step on a catheter sensor manufacturing line
- Developed fixtures in Solidworks and had them machines
- Ran DOEs to determine which factors impacted the process step the most
- Optimized process to transform it from fully manual to mostly automatic
- In the end, decreased time spent at step by 10 times and reduced overall scrap from step by 80%

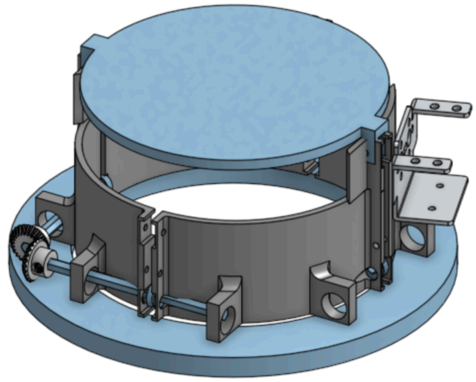
Wearable Stethoscope: Spring 2022

- Aimed to automatically detect Chronic obstructive pulmonary disease (COPD) and cardiovascular disease (CVD)
- Assisted Dr. Sung Hoon Lee with fabrication and testing with the Bio-Interfaced Translational Nanoengineering Group at Georgia Tech
- Created 10 devices which involved nano-fabrication
- Collected lung and heart sound data and applied signal processing techniques using MATLAB to isolate key sounds

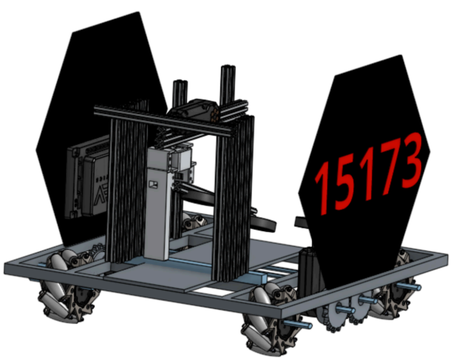
Robotics Season: 2020-2021 (FTC)

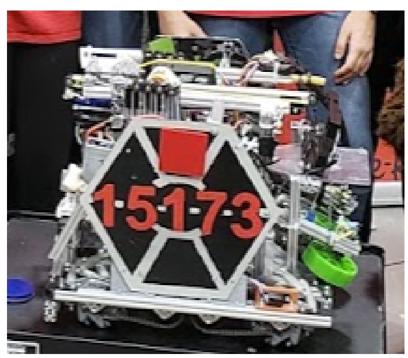


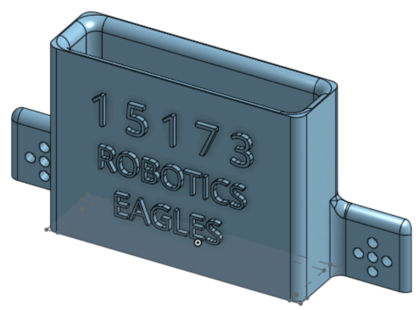


- Developed a robot to compete in the FIRST FTC Ultimate Goal season
- Designed multiple CAD parts (OnShape) and programmed autonomous movement involving picking up rings and placing them based on a visual target
- Worked with odometry to achieve precise robot movement
- Developed a turret to autonomously track a target and shoot precisely into it. Used OpenCV for object detection and live tracking
- Led a team of 15 members to advance to the FIRST World Championships

Robotics Season: 2019-20 (FTC)

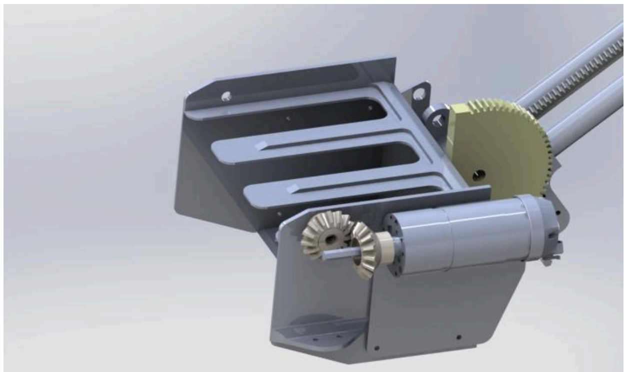






- Developed a robot to compete in the FIRST FTC Skystone season
- Designed multiple CAD parts (OnShape) and programmed autonomous movement involving picking up large blocks and stacking them based on a visual target
- Designed a passthrough intake mechanism with a double lift to efficiently pickup and stack blocks on a sliding platform
- Led a team of 12 members to advance to the FIRST World Championships

Robotics Season: 2018-19 (FTC)



- Helped develop and build a robot to compete in FTC to collect and deposit game elements
- Designed the intake for the robot in Solidworks.
- Constructed the intake using 3D printing, enabling the robot to take in several items at a time to optimize the score