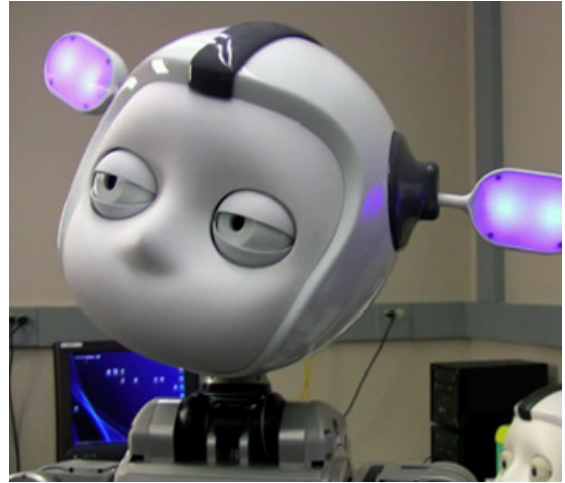
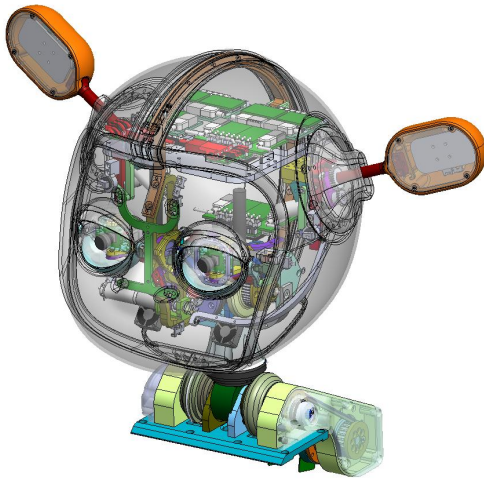


NICK DONALDSON – ROBOTICS PORTFOLIO

415-378-7250 ▪ nick@gotrobots.com ▪ www.gotrobots.com

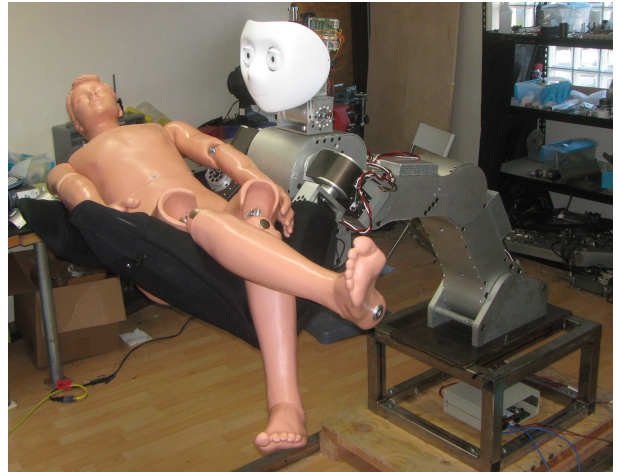
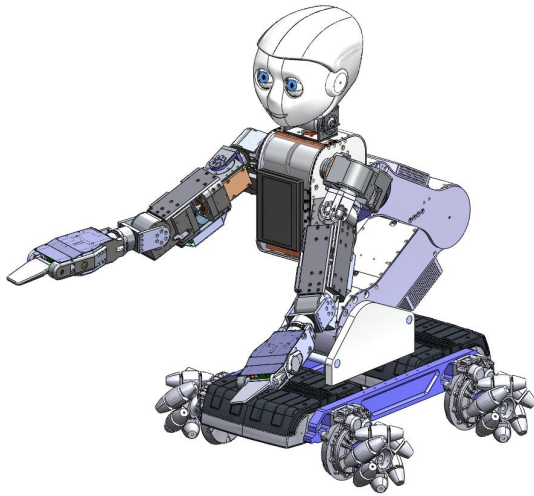
Meka Head (www.gotrobots.com/mekahead)

Working with Meka Robotics I designed and built this 13 DOF expressive head for Georgia Tech, incorporating a harmonic drive powered wire differential neck, independently moving eyeballs, eyelids and ears.



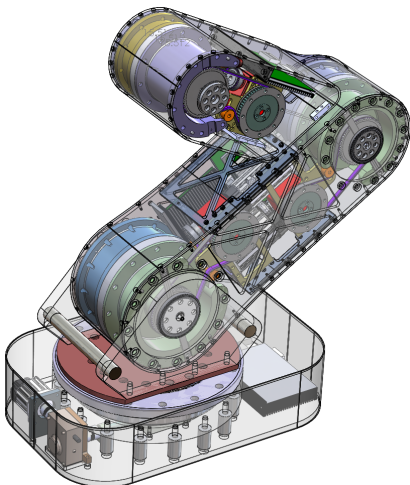
Hstar RoNA

Heavy lifting Robotic Nurse's Assistant with a 300lb payload capacity. With a simplified expressive head, series Elastic Actuators in the arms allowed force feedback compliance for safe patient interaction.



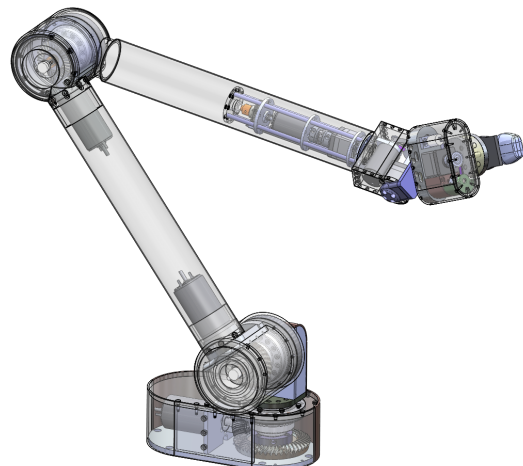
RoNA Linkage Redesign

4 DOF heavy duty linkage mount for RoNA, optimized to reduce mass, while still being able to support RoNA. As it leans forward to pick up a patient,



RoNA Sensor Arm

Third arm designed to deploy ultrasound sensor in any orientation whilst applying sufficient pressure to get a successful reading.

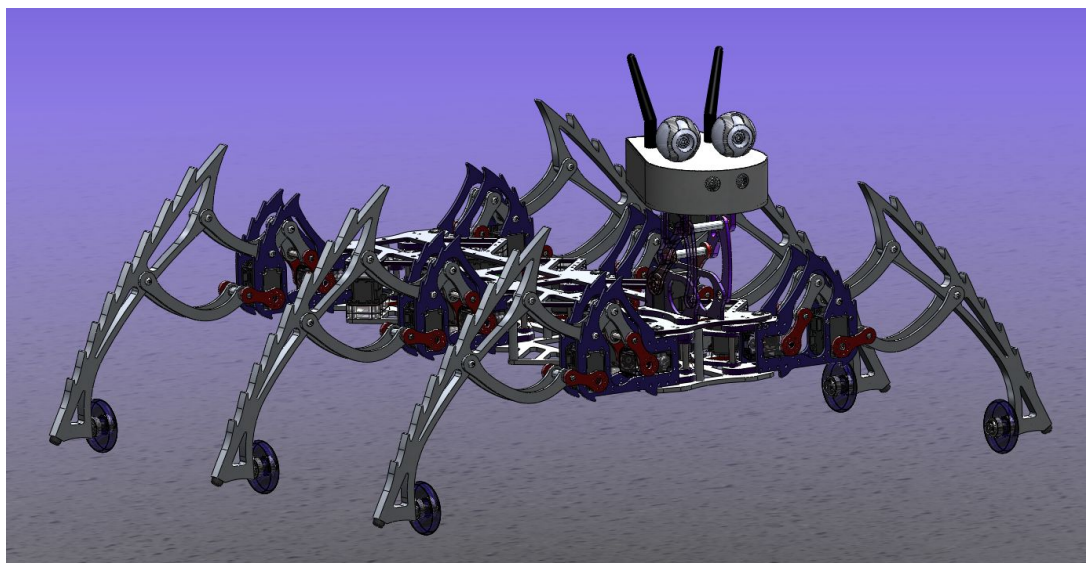


Glider - Bi-Modal Walking / Skating Hexapod Robot (www.gotrobots.com/glider)

Glider was my first skating robot. The robot can walk in a variety of gaits using its 3 DOF legs and with legs fully extended the wheels engage allowing for skating at speed. The IK based Python software provides smooth and lifelike motion. Structurally, Glider is an exercise in inexpensive robot construction; using laser-cut plates for all non-axle structural components lowered the cost significantly over traditional machining.



The robot has 20 DOF, 3 per leg with a pan/tilt head. The locking linkage leg design reduces motor load.



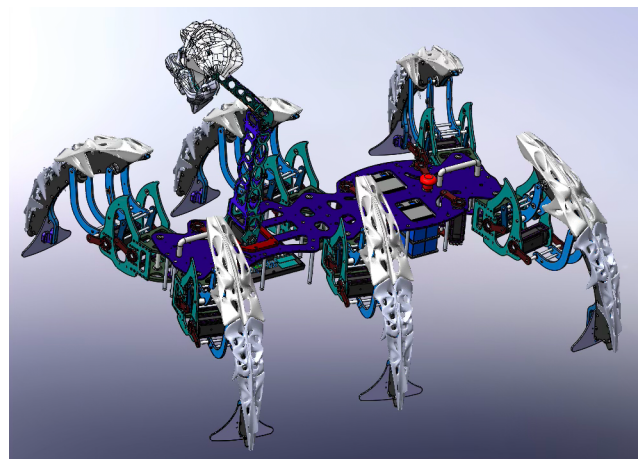
Glider in skating mode with legs deployed to engage the wheels. The leg linkages also lock in this configuration. Glider won Gold in the Walker Challenge and Silver in Best of Show at RoboGames 2013.

Marauder - Large Scale Walking / Skating Hexapod Robot (www.gotrobots.com/marauder)

Marauder was commissioned by Intel as a super scale version of my skating robot Glider. The robot is over 5' long and weighs in at 250lbs. I upgraded the robot to incorporate non-contact hall effect foot sensors so it can detect foot falls and walk over uneven terrain, and it now has a full light show with over 700 LEDs. Marauder won Best of Show at RoboGames 2023.



Marauder is entirely fabricated from water jet cut plates and relies on an energy efficient leg linkage mechanism that results in an 8 hour runtime from a 1000WH battery. It can skate at 4mph, faster than a human walking pace when on a flat surface, then revert to walking for uneven surfaces. It can be equipped with custom ice skates for fast locomotion on ice.



Blader - Compact Walking / Skating Hexapod Robot (www.gotrobots.com/blader)

Blader is the third iteration of the skating hexapod robot platform, and is exactly 1/4 the size of Marauder. The robot runs the same Python software as Marauder but runs on a Raspberry Pi Zero 2W. Again, all parts required to build the linkage based robot are laser cut aluminum so the robot weighs less than 2lbs.

Originally designed as an educational robotics kit, the robot has been upgraded with a pan/tilt head and LEDs on head and neck to match Marauder.

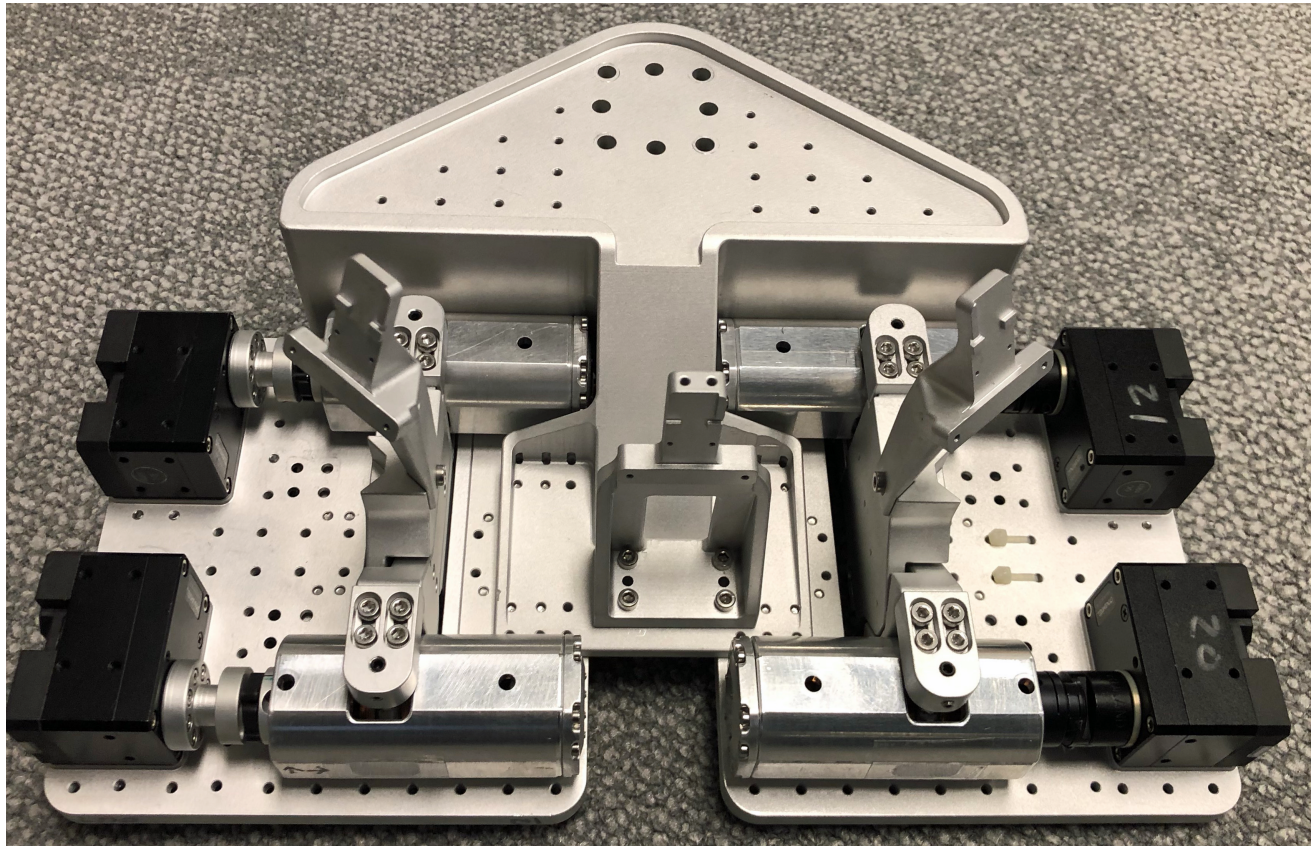


For RoboGames 2023 I designed a replication mechanism so the smaller robot could be transported underneath the larger robot and dropped on command, allowing Marauder to “replicate” by deploying a smaller version of itself. It, too can be equipped with ice skates.

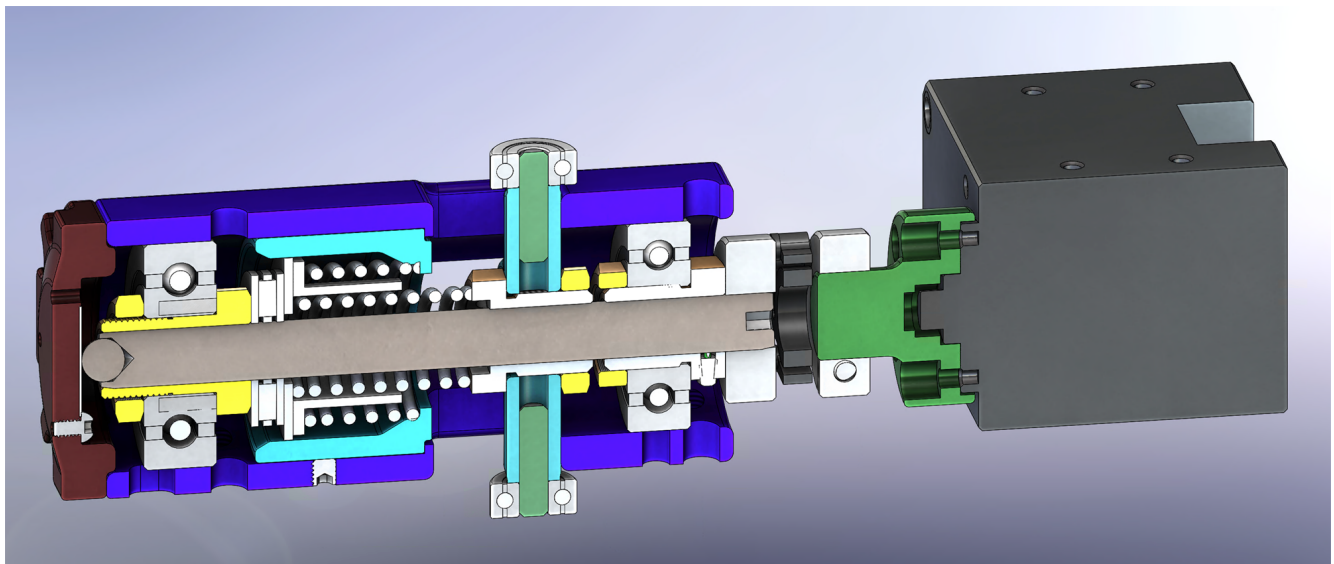


High Accuracy Displacement Device (patents.justia.com/patent/12170848)

I designed and built a high-accuracy dual-slider positioning device utilizing a spring-loaded ThorLabs 1/4-80 threaded rod connected to an inexpensive 4096 tick servo motor, resulting in 327680/in or 12880 ticks/mm. Together with novel overshoot logic that I coded in Python, this device was capable of repeatedly achieving a positional tolerance of $< 0.1\mu\text{m}$. The novel mechanism was issued US patent # [12170848](https://patents.justia.com/patent/12170848).

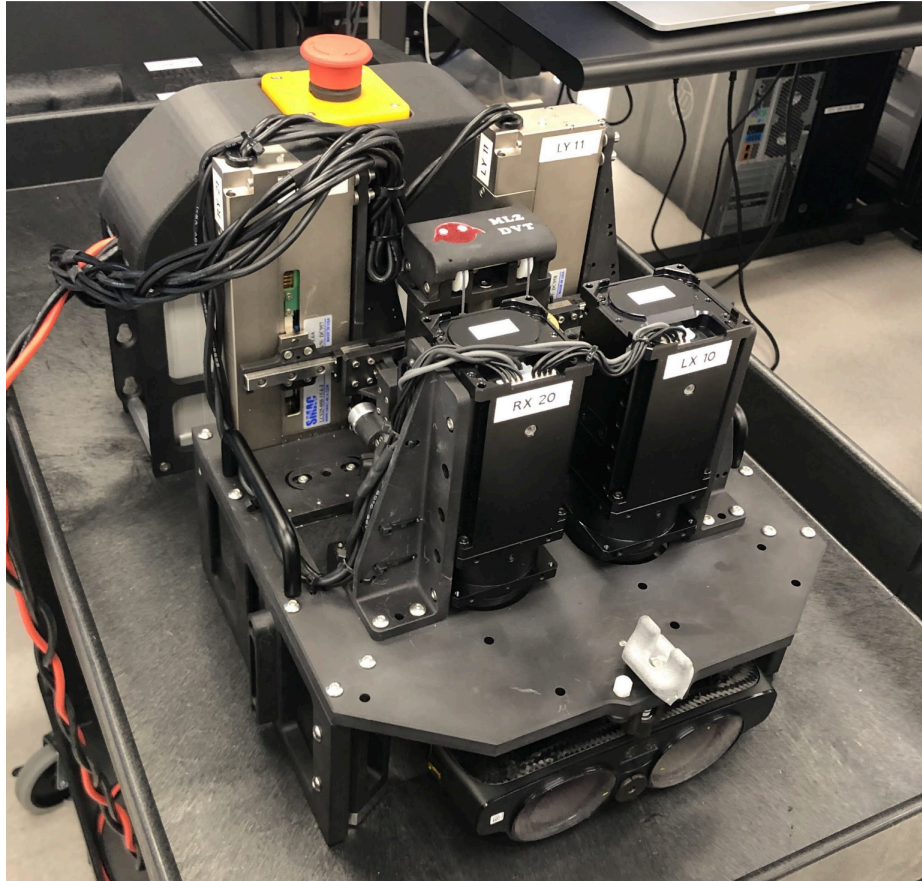


Translation and rotation were achieved by mounting two of these positioners in parallel, connected by a linear slide. A camera was then mounted via a Maxwell kinematic coupling and could be driven very precisely with respect to an AR display.

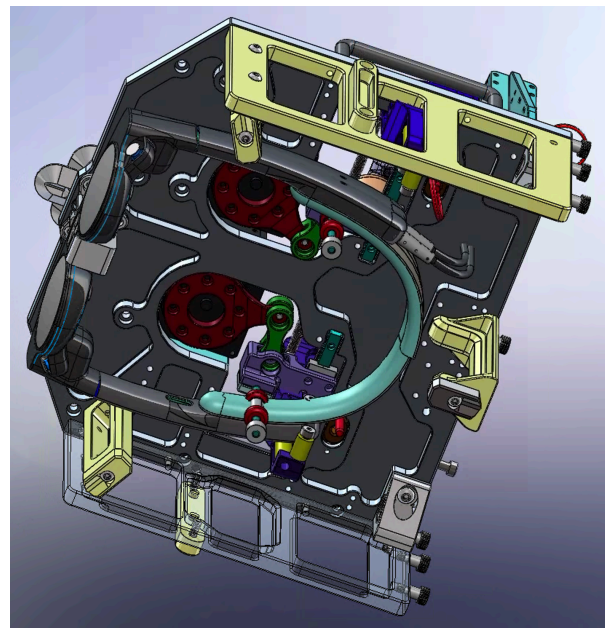
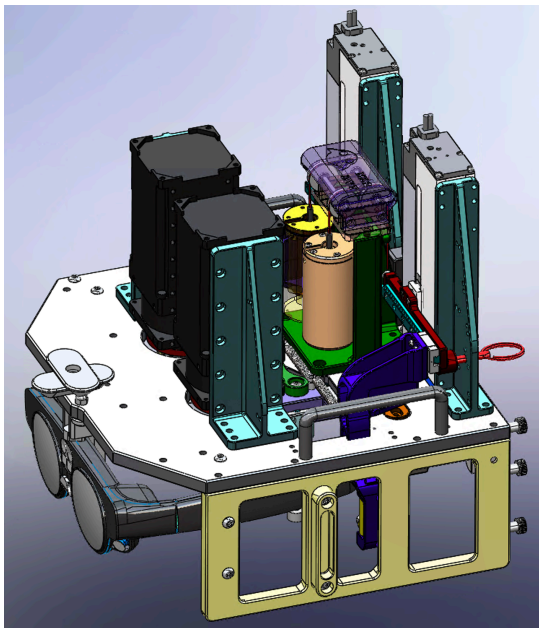


Design Validation Testing Deformation Device

The DVT deformation device was commissioned to test and validate AR devices during manufacture at the factory. It tested several aspects of the device including temple extent movement and calibration distortion due to temple deformation.

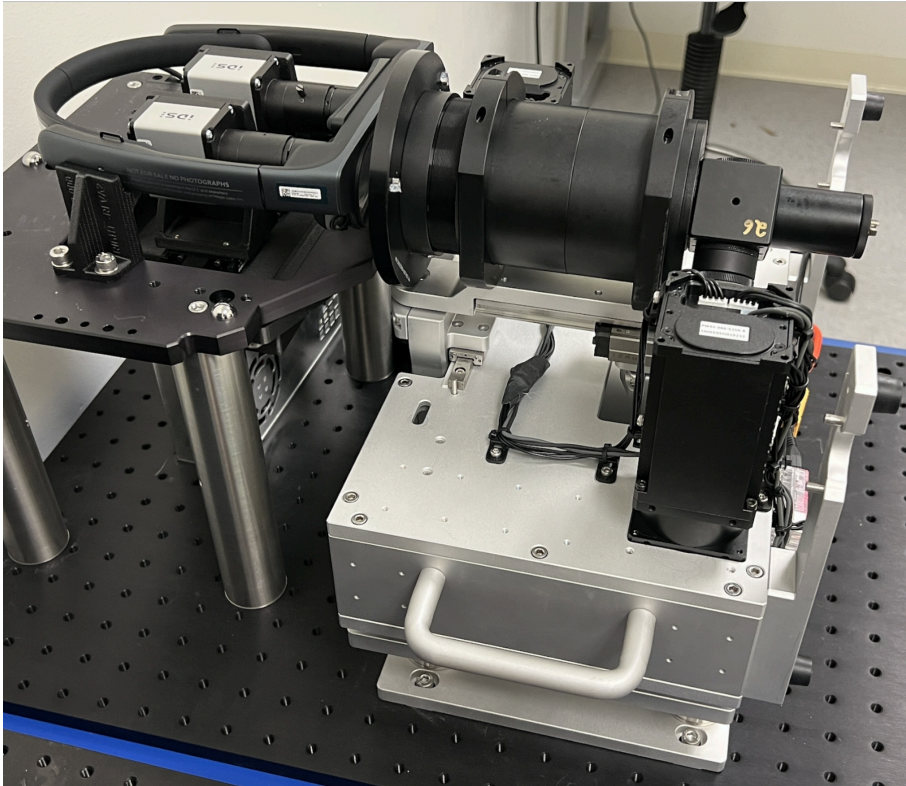


The mechanism incorporates a highly sensitive but underpowered vertical linear actuator capable of measuring the force on the device. A tunable wire and pulley counterweight was incorporated to compensate for the weight of the moving assembly parts.

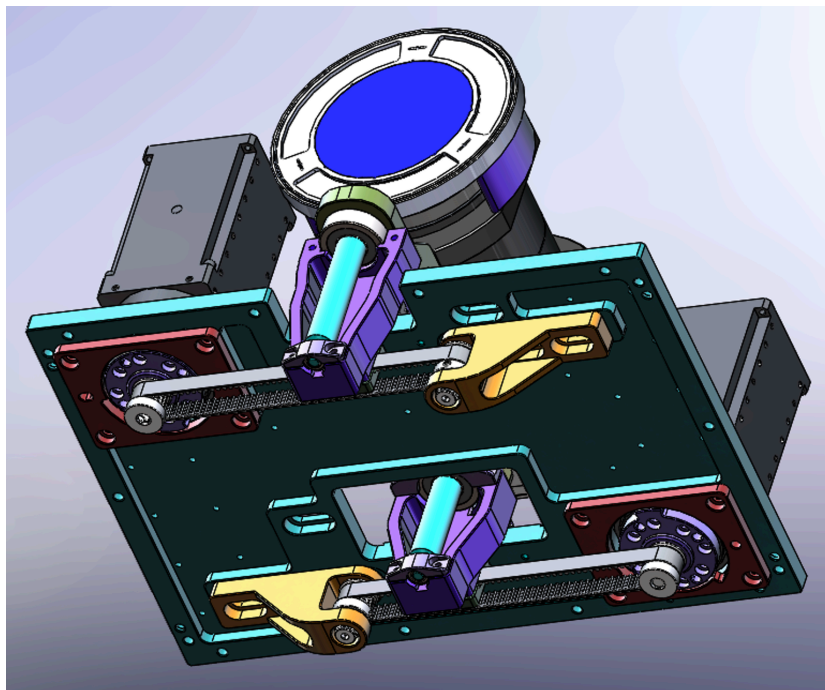


Diffraction Optic Element Translation Mechanism

The DOE translator provided extremely precise translation and rotation of a diffracted laser pattern optical element relative to AR displays. Utilizing high end robotic actuators with 500K ticks per revolution, coupled with belt driven linear slides the translator was capable of achieving repeatable sub-micron accuracy. I also wrote a Python Textual UI program for mechanism control that incorporated overshoot / seek logic to maintain the required accuracy.

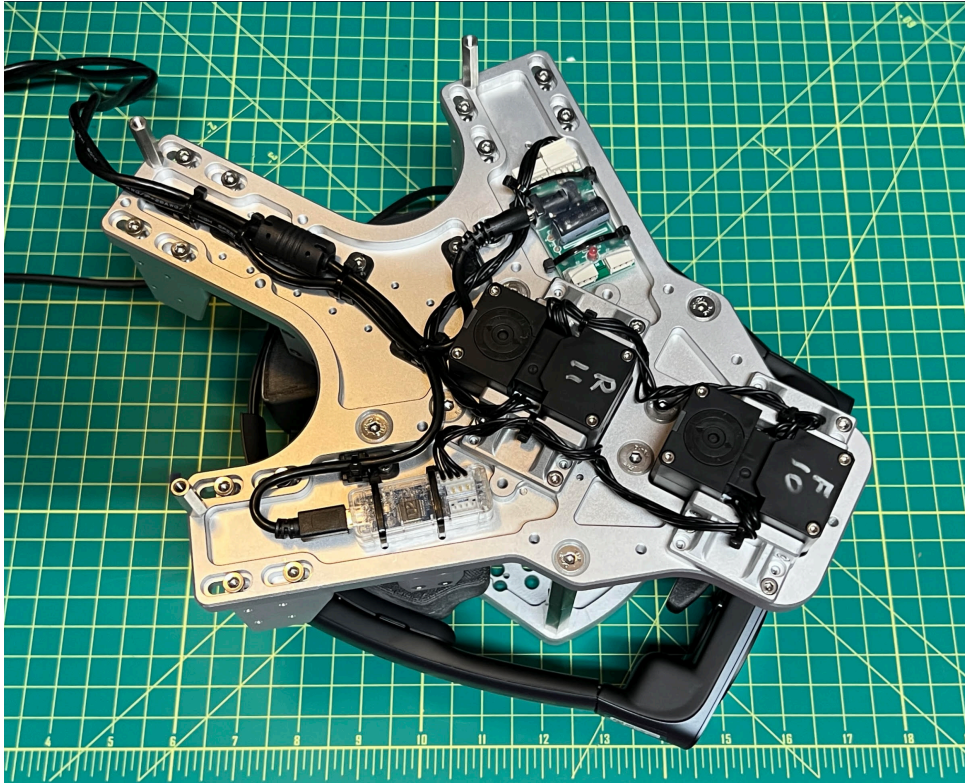


Front and back modules were connected with a linear slide and the entire mechanism was movable to three different locations using kinematic couplings.

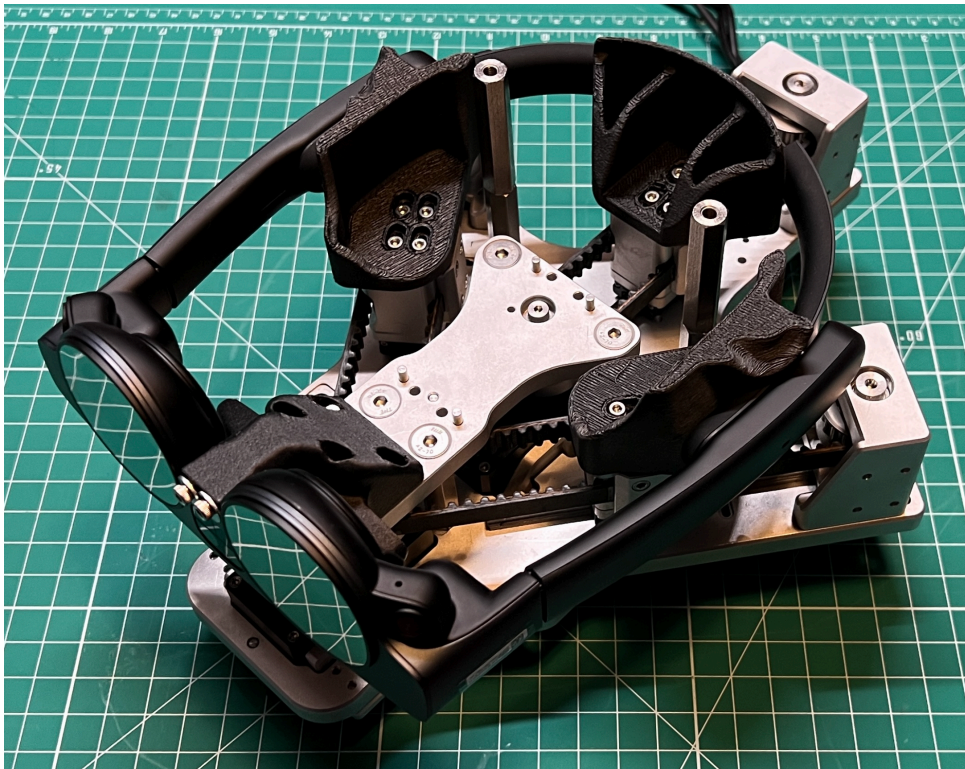


Head Simulator

A mechanism to simulate a variety of human head shapes by modifying ear spacing and front/back distance. The head simulator allowed for testing of calibration affects of different head sizes on AR devices.



3D printed ears and a head back pad were driven in and out on belt drive linear rails. The entire mechanism could be mounted to a robot arm for full calibration testing.



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Bot & Dolly Robotic Art Car Paint Cannon (www.gotrobots.com/robotic_art_car)

This remotely controlled pan/tilt paint cannon was built for an extended car commercial art project. It deployed out of the sunroof and was operated from a control panel in the car, allowing the driver to aim and fire paint balls at a wall. See it in action at <http://youtu.be/f7Y6kl94X-A>



The system was controlled by a custom built dashboard providing arming, tube select, slew speed, pan/tilt control and a firing button, together with a monitor for aiming.

Neato Robotics XV-11 (www.neatorobotics.com)

For the laser guided autonomous navigation vacuuming robot I designed the drive train, designed to provide sprung suspension with the capability to climb a 1" step, and the Laser Distance Sensor, a spinning optics block capable of measuring from 15cm to 6m with an accuracy of 2-3cm at 5 Hz. I also built a series of prototypes used for testing a variety of the technologies used in the robot.



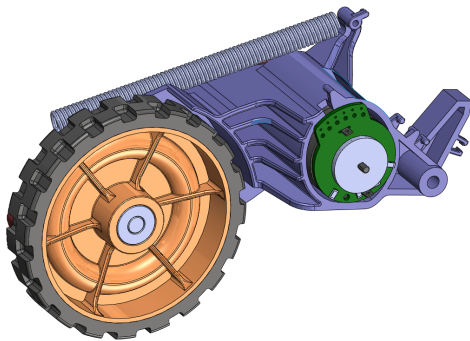
Early Prototype with LDS



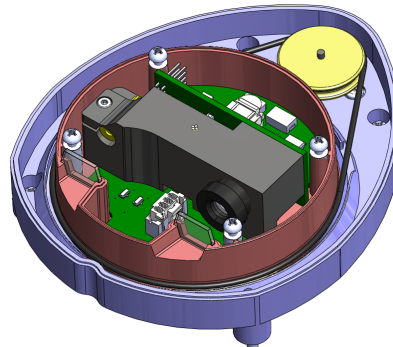
EVT Prototype



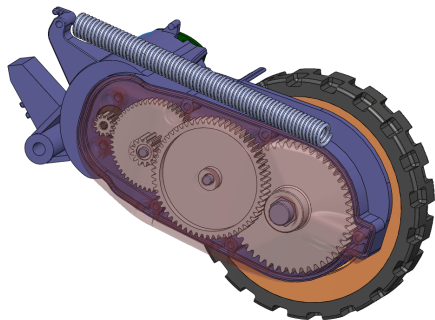
Final retail product



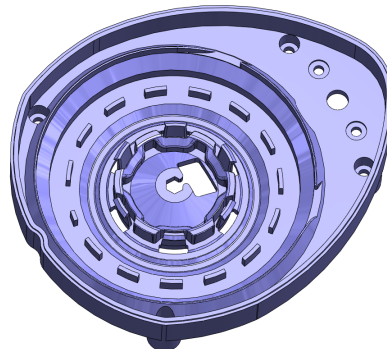
Drive train side view



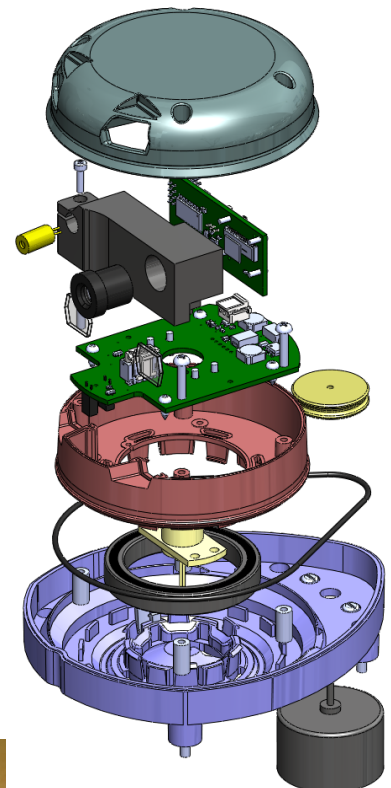
LDS top view



Drive train gear train



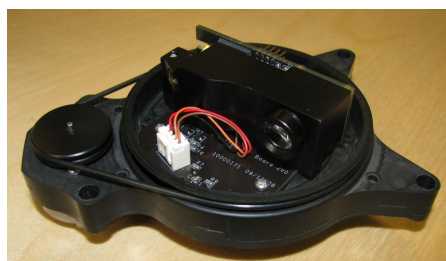
LDS tray with molded bearing clips



LDS exploded view



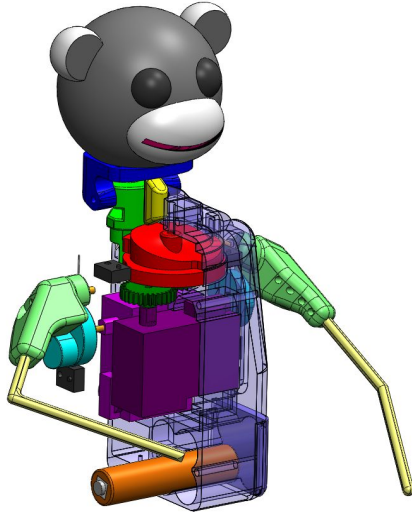
Drive train prototype



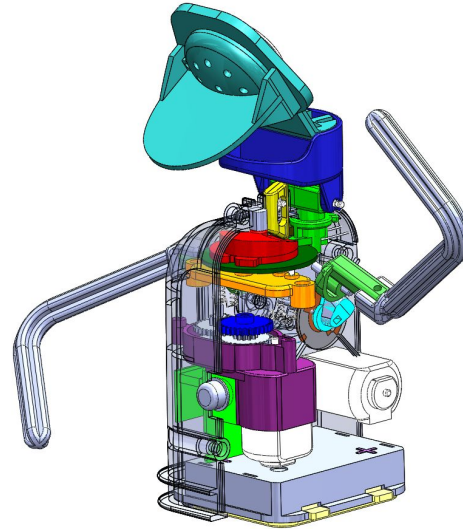
LDS early prototype

Cheeky Monkey / Dave the Funky Monkey Toy (www.gotrobots.com/dave)

I designed this shoulder sitting robotic monkey, utilizing cams to actuate four independent motions (head turn, nod and left and right arms) using two motors. After 8 years in development it finally hit the shelves in 2010, becoming the fifth best selling toy of the holiday season in the UK. I have since cost-reduced the design by integrating all motions onto a single motor driven cam system.



Original prototype CAD



Final toy moldable CAD



Original FDM prototype



Final toy in packaging



Final toy mechanism

