ANNA MILLER

Engineering Design Portfolio

Prior work performed at Cambridge Consultants is confidential, and cannot be relayed in a portfolio.

For examples of project types, please see:

https://www.cambridgeconsultants.com/us/case-studies

WILLOW

RESEARCH AND DEVELOPMENT INTERN

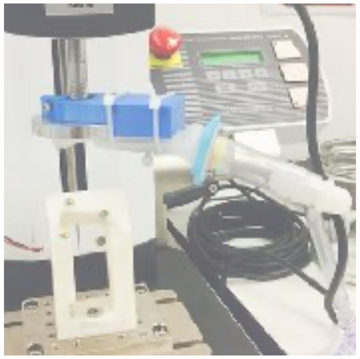
Time Period: Summer 2017
Location: Mountain View, CA
Project Team: Willow R&D Department

Challenge:
The Willow team developed a wearable, inconspicuous, and hands-free breast pump.

Personal Impact:

- Created fixture and test set-up for characterization and further optimization of linear actuators
- Conducted final volume verification testing
- Tested iterative design solutions for volume tracking
- Investigated ongoing learnings from the field
- Evaluated and tested pumps from ongoing user and lab testing
- Ordered lab equipment

Working in a fast-paced start-up environment, I learned about the practical aspects of the entire product development process.



Fixture for testing linear actuators

AIMGRO *AERIAL INSERTION MICRO GROUND ROBOT*

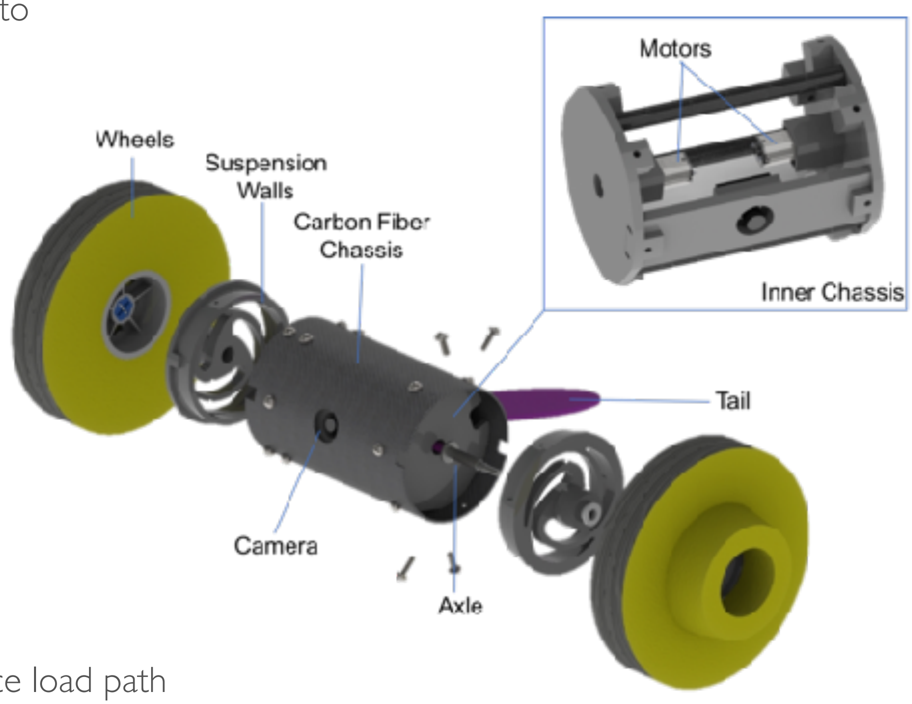
ENGINEERING METHODOLOGY CAPSTONE PROJECT

Time Period: September 2016 to March 2017
Project Team: Class project, team of eight

Challenge:
Contracted by the Physical Sciences Inc. (PSI) InstantEye division to create a deployable payload for an aerial drone that can explore terrestrial areas and relay video, e.g. to find IEDs under vehicles.

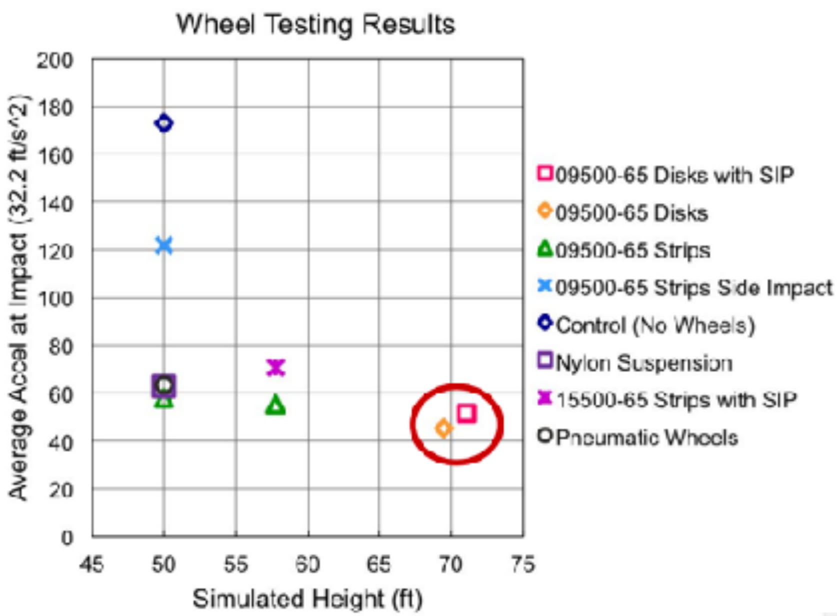
Solution:
A lightweight, wheeled robot that can survive falls from low heights and navigate on flat ground.

Results:
The team worked with PSI to determine project parameters, and developed a prototype to be used for proof of concept and recommendations for future development.

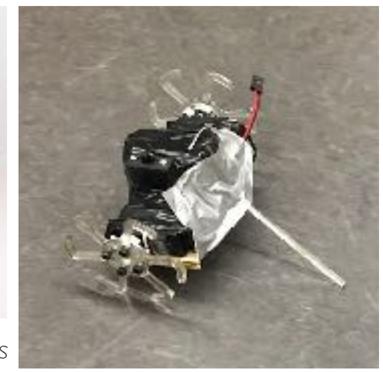


Personal Impact:
- Calculated necessary axle strength and survivable velocities
- Conducted mobility and drop testing
- Completed failure modes effects and criticality analysis
- Used Solidworks Finite Element Analysis to determine the force load path
- Machined carbon fiber body
- Maintained bill of materials, monitoring vehicle mass
- Created initial design sketches
- Researched state-of-the-art designs

A weighted rig was used to simulate forces from high altitude drops, with an accelerometer and slow motion camera measuring impact severity.



The greatest challenge of this project was the vehicle surviving the fall from the drone. Size and mass of the vehicle needed to be minimized for tactical drone flight (but this was limited by the electronics for vehicle operation). This influenced many design decisions, like making a two-wheeled vehicle to minimize actuators.

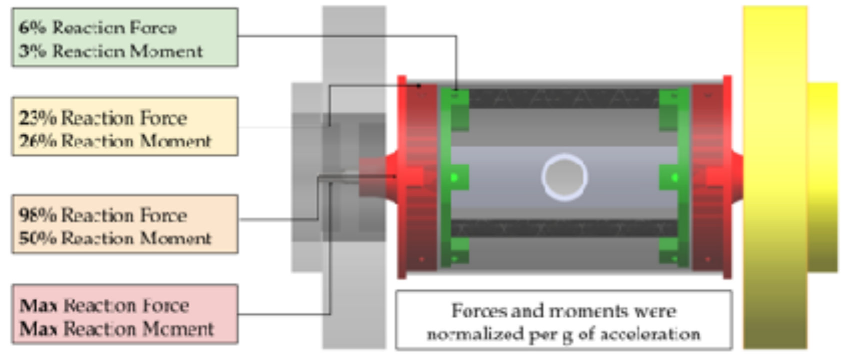


Early prototypes for sizing, mobility, and drop tests

Specification Category	Threshold Specification	PSI Future Goal	Prototype
Fall Height	30'	300'	35'
Reusability	1 drop	10 drops	5 drops
Mass	680 g	226 g	669.9 g
Size	150 in^3	45 in^3	100 in^3
Drive Time	5 min	> 15 min	21 min
Mobility	Flat hard ground and packed dirt	Sand, dirt, small obstacles up to 2"	Flat hard ground and sand
Drop	N/A	20° cone	9° cone
Impact Noise	N/A	<85 dB	79.5 dB
Cost	<$3,000	<$500	$525

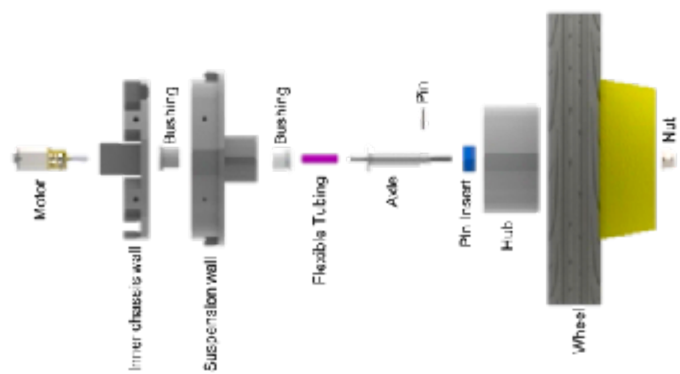
The prototype needed to satisfy a large number of physical and functional specifications in order to be effective.

Final Prototype



Transmission of forces through the drive train, as analyzed in Solidworks

To minimize visibility, the sponsor did not want to employ a parachute or other drag device. We relied on a flexible drive train and wheels made of Poron XRD® to damp impact forces and protect the motors.



Exploded diagram of the drive train

MICROWAVE BREAST IMAGING

MICROWAVE IMAGING AND SPECTROSCOPY RESEARCHER

Time Period: Spring and Summer 2016
Location: Dartmouth Microwave Imaging and Spectroscopy Lab
Project Team: Individual work supervised by a professor

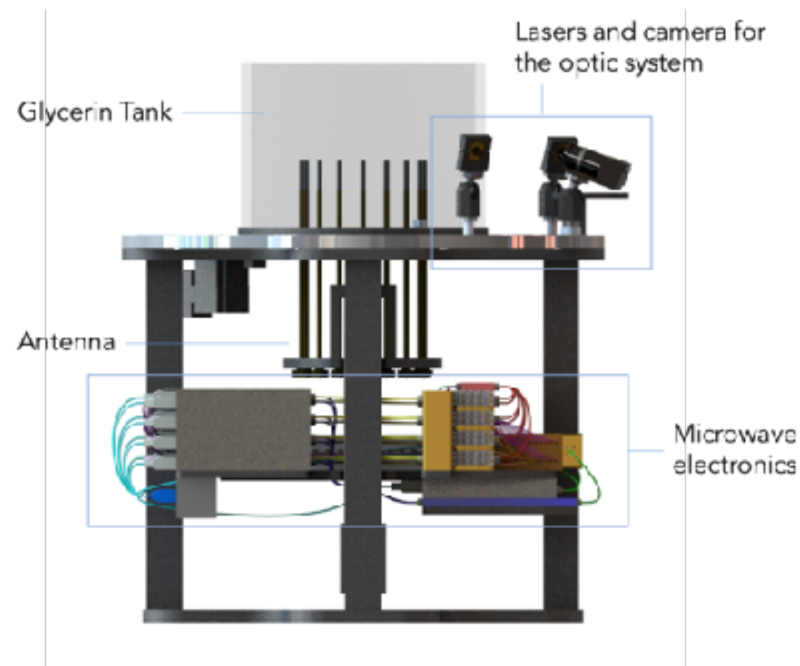
Challenge:
The lab is working to develop a microwave breast imaging device for cancer diagnosis and treatment. My specific project was to design new housings for the electronic control boards.

Solution:
Aluminum housings that provide signal shielding and promote simple cable organization.

Results:
A new electronics organization system that attaches to the existing imaging device.

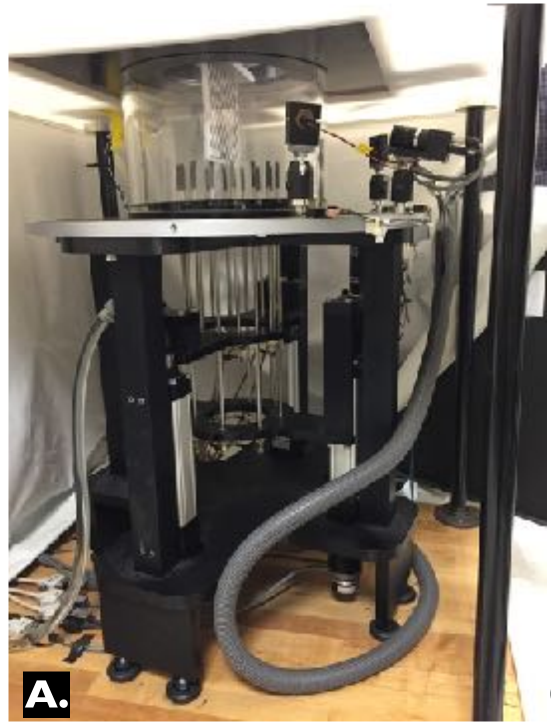
Personal Impact:

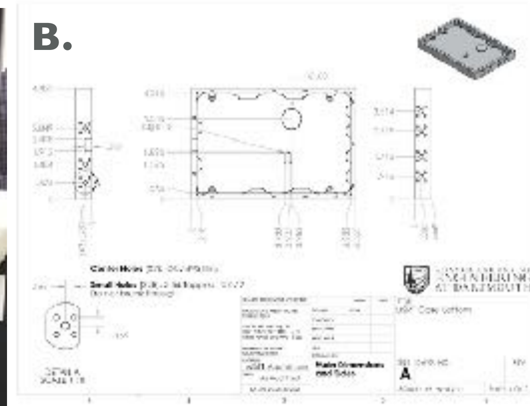
- Designs for a new electronics housing
- Designs for attachments and supports for proposed housing arrangement
- Drawings for new parts
- Coordinated with machinists for manufacture
- Worked with General Electric to improve designs
- Improved and collected CAD model for the entire device

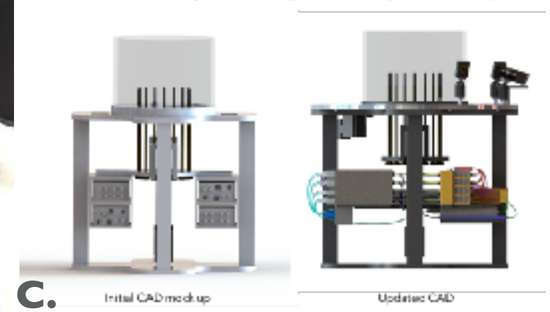


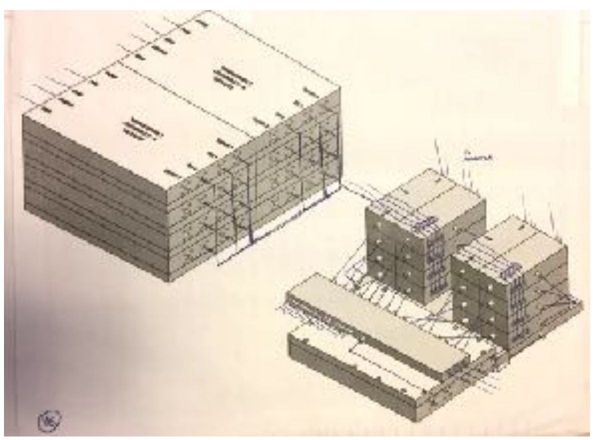
While earlier iterations housed the control circuitry in a completely separate unit, technology advancements have made it possible to fit them under the scanner, reducing the overall footprint. I determined how to organize and attach the circuits to make this possible.

A: Photo of the current device
B: Drawing for the USRP board case bottom
C: CAD before and after electronics changes

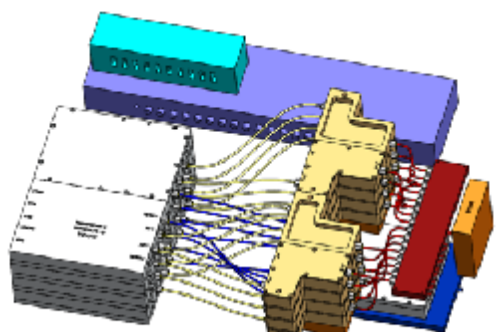




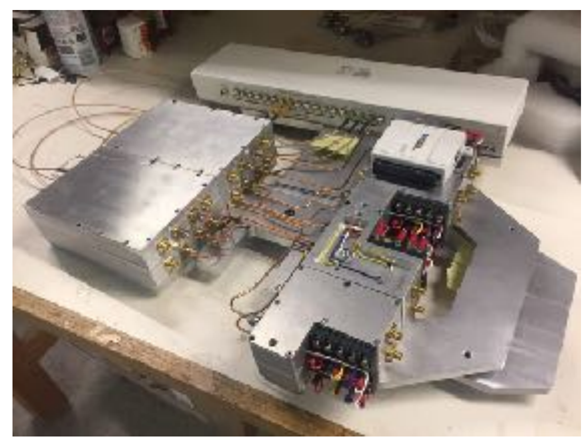




Initial test sketches for wiring



Solidworks iterations to develop the yellow housing and simplify wiring



Fabrication of housings and support structures

THE WALKING MONSTER

COMPUTER-AIDED MECHANICAL ENGINEERING DESIGN

Time Period: Spring 2016
Project Team: Class project, team of five

Challenge:

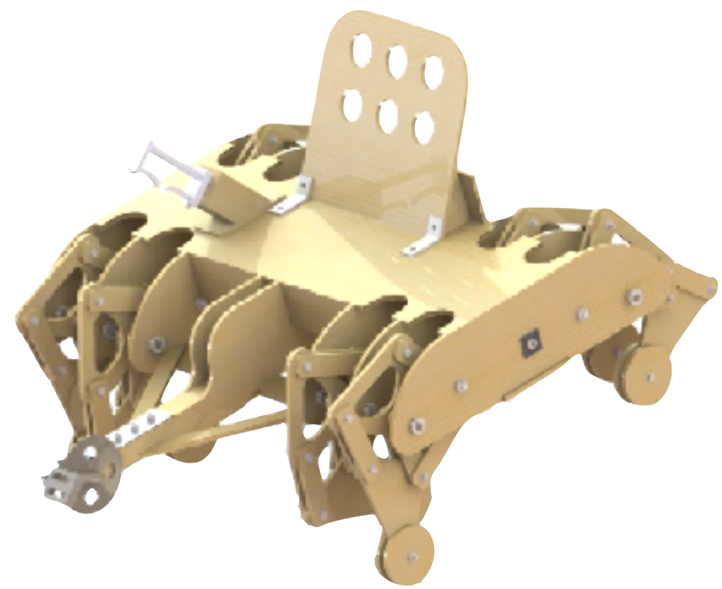
In five weeks build a jousting machine…

- With no wheels
- Powered by a seated, pedaling human
- 3' x 4' x 5'

In a joust, use a mounted lance to knock a magnetic ring from an opponent.

Solution:

Inspired by Theo Jansen, we created an eight-legged walking monster using Solidworks, CNC milling, plywood, and bicycle parts.



Results:

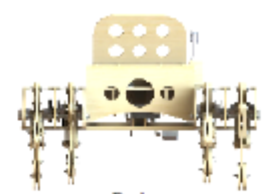
A close second place in the jousting competition, and the only machine that could walk forwards, backwards, and turn.

Personal Impact:

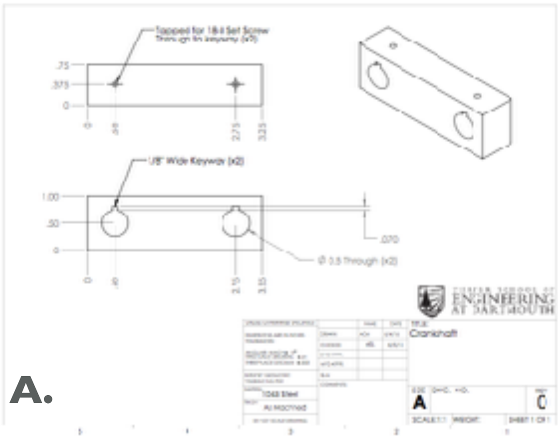
- Designed and fabricated the differential
- Designed and fabricated the pedal assembly and attachment
- Machined steel crankshaft pieces
- Created most part drawings
- Designed side walls
- Contributed to general assembly

Front

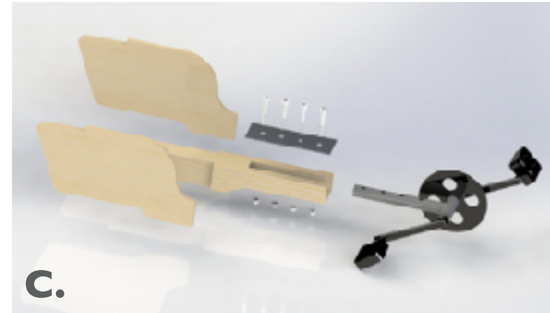
Side



Back


A.


B.


C.


D.


E.


F.

Design Challenges

Simplification

The short project timeline required a design that is easy and quick to assemble. Plywood pieces were designed with cuts to mechanically align pieces, and to take advantage of the precision and speed of the Thayer School Shopbot.

Leg Stability

Initial walking test showed that parts of the leg were prone to bending on uneven surfaces. These vulnerable pieces were reinforced during the jousting competition.

Images

A: Drawing for the steel crankshaft components

B: Final assembly, after the jousting tournament

C: Exploded view of the pedal assembly

D: Exploded view of the differential, with differential as the overset

E: Differential in assembly with the driveshaft and brake system

F: Shopbot cutting out the assembly sidewalls

RC WALKING ROBOT

MACHINE ENGINEERING

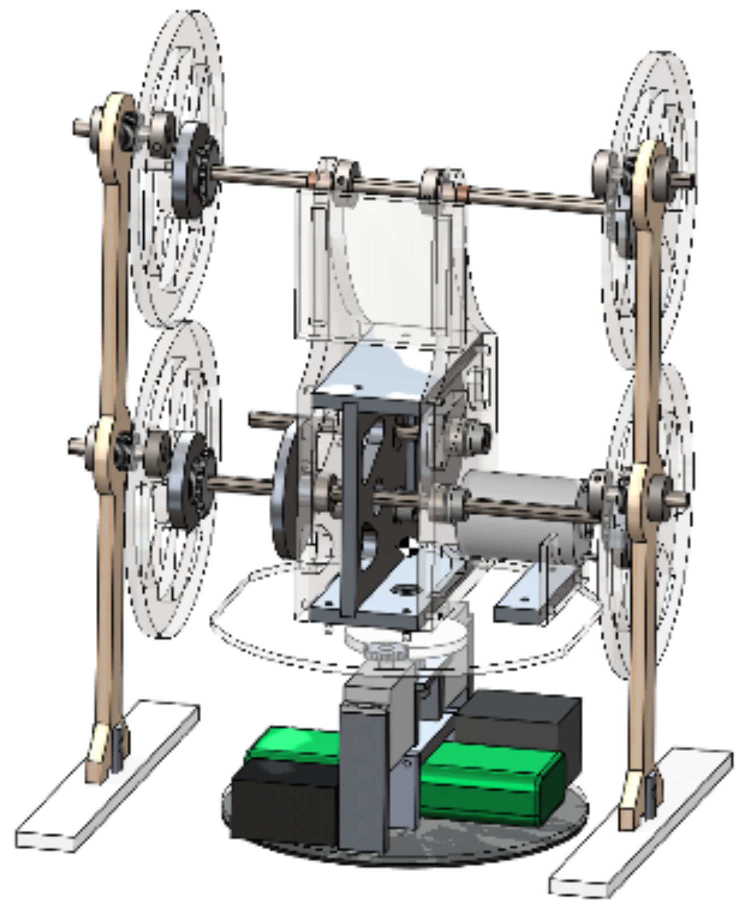
Time Period: Fall 2015
Project Team: Class project, team of three

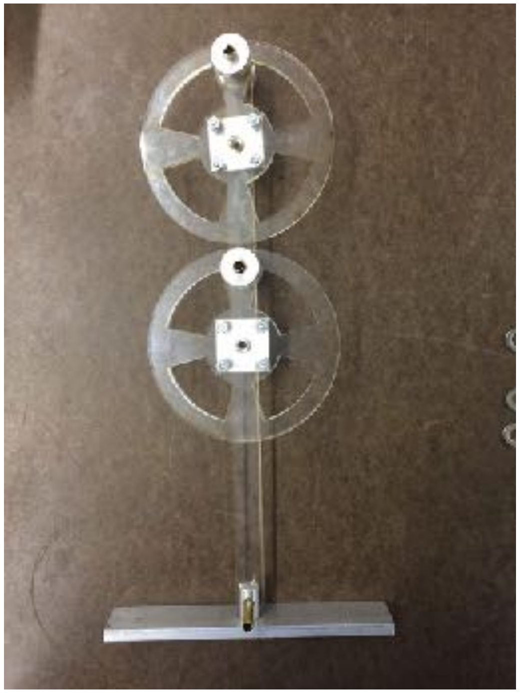
Challenge:
Create a remote controlled vehicle, without wheels, that can navigate a maze, 1' wall, and series of pegs, using parts from a remote controlled car and parts fabricated from stock.

Solution:
A two-legged walking robot with 360° point turning.

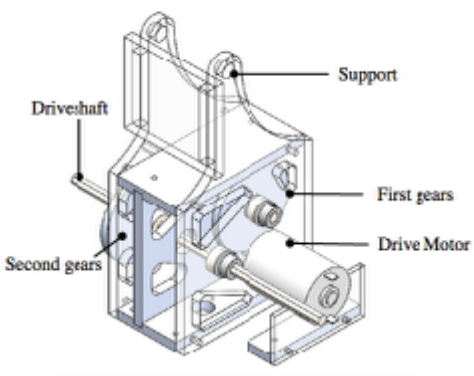
Results:
Successful navigation of the maze obstacle, challenged by the wall and peg forest obstacles.

Personal Impact:
- Point turning concept
- Designed and fabricated leg attachments
- Lead for Solidworks assembly
- Laser-cut chassis iterations
- Fabricated shaft collars
- Contributed to general assembly





Above: Leg Assembly *Below:* Gearbox CAD



Design Challenges

Power and Legs

The vehicle was too heavy to be lifted by the provided battery and motor. The motor was geared down, and acrylic and wood were used as lightweight materials.

Chain Tensioning

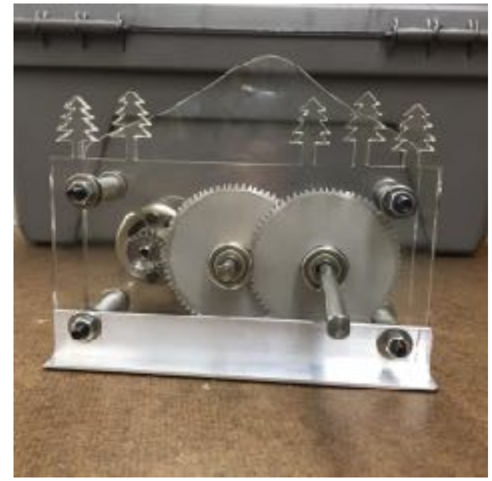
The chains linking the legs had a tendency to be too loose. This was not fully resolved, but was ameliorated by adding tensioning sprockets.

Cable Control

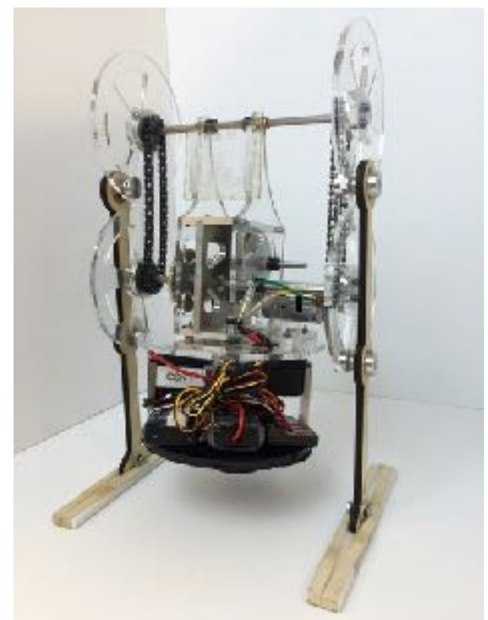
360° turning was limited by the length of the wire attaching the drive motor to the battery. At the time this was dealt with by leaving longer cables and wrapping them carefully. A better solution might have been to change the servo and battery locations to eliminate the need for longer wires.

Wobble

The vehicle wobbled relative to its direction of motion, limiting its maximum speed.



Above: Test gearbox *Below:* Final Assembly



Thank you for taking the time to look at my work!

I would be happy to discuss these projects and my other experiences further.

Contact me at
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