Robert Duquette

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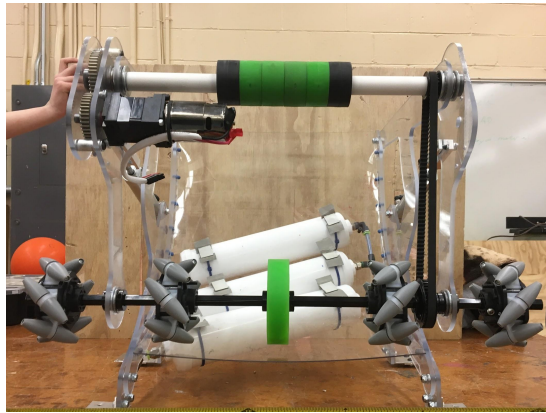(734)-635-7273
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Robotic Kickball Intake - FIRST FRC Deep Space, Team 3322
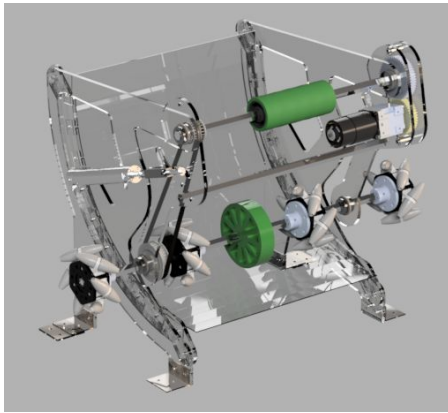
CAD Rendering

Assembled intake mechanism

Fully Assembled Robot

What?

- Robotic mechanism to collect kickballs off the ground then feed them to an outtake
- Pneumatic actuation to extend outside the frame for collection and back inside to avoid damage

How?

- Prototyped with wood, dolly, spare parts, and power drills
- Designed in Autodesk Fusion 360 to be cut out on a CNC router
- Performed kinematic analysis to optimize ball collection
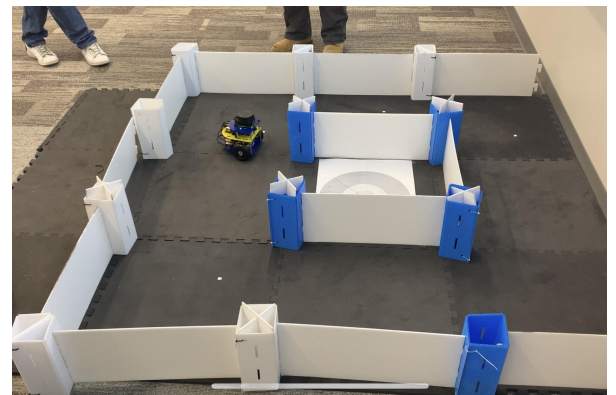
Results

- Reliable ball intake throughout the competition season and off-season
- Durable and lightweight polycarbonate design lasted the whole competition season

Maze Escape Robot - ROB 330

MBOT tuned wheel PIDs
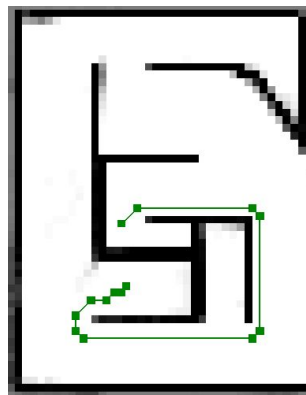
A* path generation

Robot exploring and mapping maze

What?

- Wrote probabilistic SLAM and navigation algorithms for an autonomous mobile robot to map and escape a maze
- Implemented an AI image classification model onboard the robot

How?

- Two layers of PID control, for wheel speed and robot speed.
- Probabilistic SLAM algorithms - action & sensor models, particle filter to process LIDAR data
- Navigate to frontiers with A* through obstacle distance grid.

Results

- Full exploration and mapping of a 3x3 maze, as well as escape out of the maze after a wall panel was removed
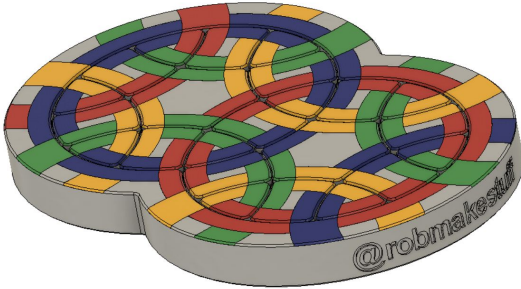- 65.8% accuracy on 10000 test images using a CNN model

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3D Printed Geranium Puzzle

CAD model

Operation 3/5 of the printing process

Solved puzzle Scrambled puzzle

What?

- Designed and created a 3D printed-in-place geranium puzzle (similar to a Rubik's Cube)
- Demonstrated multi-material printing capabilities on a single nozzle printer

How?

- Modeled in Autodesk Fusion 360 and toleranced to print in place
- Created STL files for each different color on the puzzle
- Wrote custom G-CODE to run multiple operations and ensure a consistent origin reference point
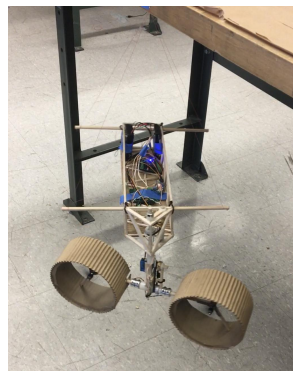
Results

- Validated multi-material 3D printing technique
- Smooth turning, non-locking, visually pleasing puzzle
- Produced several prototypes to validating the mechanism and tolerances

Blimp Thrust-Vectoring Propulsion Subsystem - ENGR 100
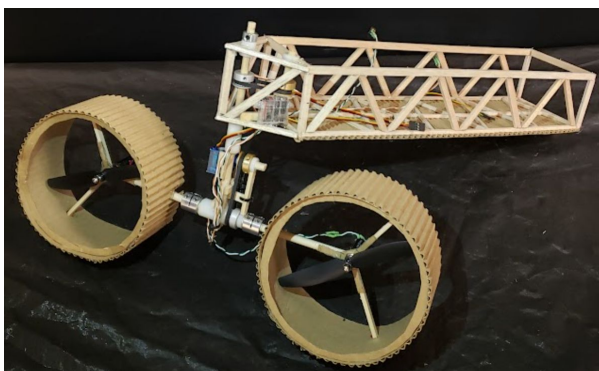
Assembled gondola + propulsion system

Maneuverability testing

Final blimp in competition

What?

- Propulsion system for a remotely operated blimp
- Lightweight construction minimizing weight and maximizing maneuverability

How?

- Designed and fabricated a 2 DOF thrust vectoring propulsion mechanism
- Tested by hanging from a single point to ensure maneuverability before flight testing

Results

- Won 1st place in all events in competition (speed and recon) against 11 other teams
- Thrust vectoring system with 2 DOF provides excellent maneuverability