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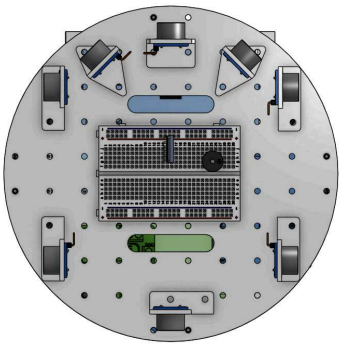
Autonomous Maze Rover

University of Toronto, MIE444 (Mechatronics Principles) · Team of four

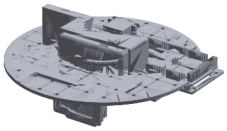
Mechanical CAD | Control software

An Arduino rover that localizes in an unknown maze, avoids walls, and delivers a block to a target zone.

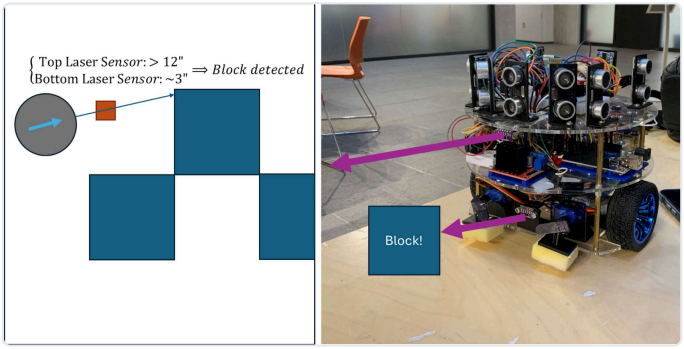
Our team built a rover that drives an unknown maze on its own, locating a block and delivering it to a target zone. The platform runs on Arduino with ultrasonic and laser sensors, a servo-driven gripper, and a custom layered-acrylic chassis. I worked on the mechanical CAD and the localization and obstacle-avoidance code.



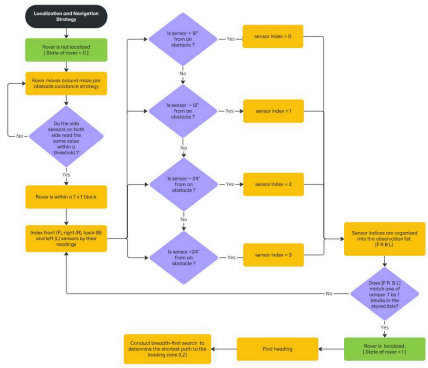
CAD assembly of the chassis with perimeter sensors and mounts I modeled.



Full rover assembly, isometric CAD view.



The built rover detecting a block with paired laser readings.



Localization and navigation: sensor indexing, map matching, breadth-first path search.

Mechanical design

I modeled the chassis and its mounting hardware in CAD. The layered acrylic platform places ultrasonic sensors around the full perimeter, including the diagonals, so the rover reads its surroundings in every direction, with the gripper underneath and the boards laid out for wiring access and balance.

Localization and navigation

The rover turns its four side readings into a front-right-back-left signature and matches that against a stored map of the maze. Once it knows which cell it occupies, a breadth-first search returns the shortest path to the loading zone.

Obstacle avoidance and delivery

A threshold strategy checks every ultrasonic sensor each cycle and realigns the rover before it reaches a wall, and a two-laser check confirms a block ahead so the servo gripper can carry it to the delivery zone. The integrated rover completed the full task; the main constraints were sensor latency and motor power under load, which tighter signal filtering and a stiffer drivetrain would address.

SELECTED REFERENCES

- S. Thrun, W. Burgard, D. Fox, Probabilistic Robotics, MIT Press, 2005 (grid localization).
- T. Cormen et al., Introduction to Algorithms, 3rd ed., MIT Press, 2009 (breadth-first search).
- M. McCauley, AccelStepper library documentation (acceleration-controlled stepper motion).

Engineering portfolio brief. Course and team project; contribution as noted above.