Micromouse - Autonomous Pathfinding Robot

Brayden Abo, Ian Nevins, Brendan Lee, Ethan Shanahan, Jeremy Mango, Ozzie KellyYuoh, Michael Buzzetta, Tav BenShoan
Department of Computer Science, Sean Watts

Micromouse IEEE Competition

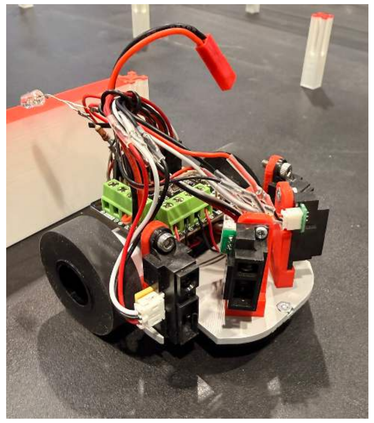
Micromouse of Long Island 2026, hosted by IEEE

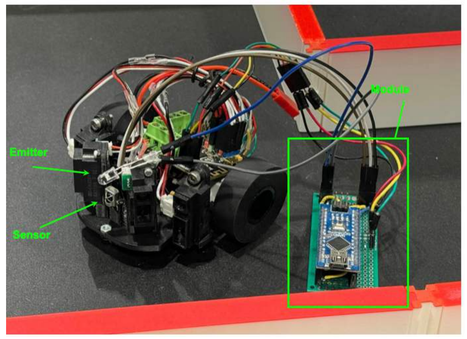
Objective: Design and build a fully autonomous robotic "mouse" to navigate an unexplored 16x16 grid of 18 cm squares.

Goal: The robot must autonomously map the maze, calculate the most efficient route from the starting corner, and reach the four-cell destination zone at the center in the shortest possible time

Constants:

- The robot's footprint cannot exceed 25 cm by 25 cm at any point during the run.
- The maze is randomized, so the algorithm must be able to handle various scenarios and layouts.





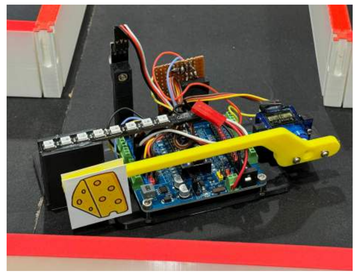
Cheese Hunt Beacon

Micromouse Cheese Hunt

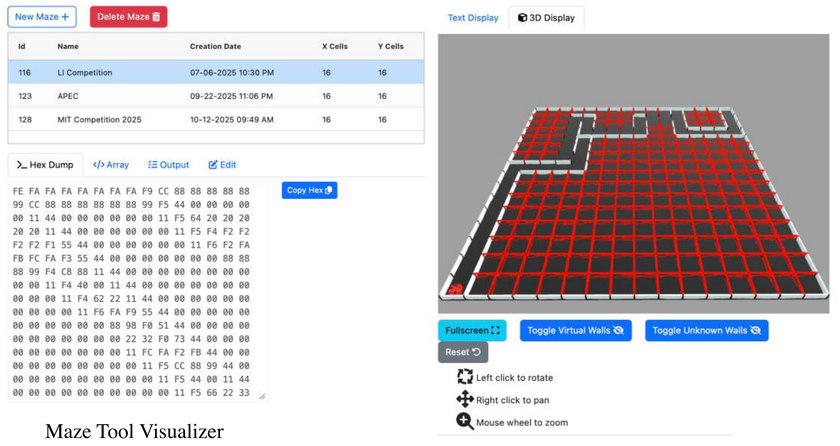
The Cheese Hunt Module is an interactive core component designed to demonstrate dynamic navigation, search mechanics, and problem-solving in real-time. By simulating a classic "mouse and cheese" scenario, this module provides a fun, easily understandable visual representation of complex backend processes.

Key Objectives

- **Target Acquisition**: Rapidly scan the environment to identify and locate the randomized "cheese" objective.
- **Dynamic Pathfinding**: Calculate the most efficient route while adapting to obstacles and changing spatial constraints.
- **Performance Tracking**: Measure and log efficiency metrics, including time-to-completion and path optimization.



Cheese Hunt Beacon



Maze Tool Visualizer

Hardware Design

Microcontroller: The Romeo BLE Mini v2 serves as the central processing unit, handling sensor polling, motor control logic, and Bluetooth telemetry for debugging.

Locomotion: Two 30:1 Micro Metal Gearmotors (HPCB 6V) drive the robot with high torque and precision. Each motor includes a 12 CPR quadrature encoder for odometry.

Sensing: Four Sharp infrared distance sensors cover the robot's field of view — two GP2Y0A51SK0F (2–15cm range) for close-range front wall detection, and two GP2Y0A41SK0F (4–30cm range) for side wall tracking. Together they give the robot full awareness of adjacent maze walls.

Power: A 2S 7.4V LiPo battery provides compact, high-discharge power suited for continuous motor operation throughout a competition run.

Chassis: A custom 3D-printed chassis holds all components within the 25cm × 25cm competition size limit, with M3 and #2-56 hardware for rigid assembly.

Navigation Aid: An L3GD20H 3-axis gyroscope provides angular rate data to correct heading drift during straight-line runs and 90° turns.

Software Design

Core Algorithm: Flood Fill (BFS) The firmware runs a BFS from the goal outward, assigning every cell a hop-count distance. The robot greedily follows the gradient — always moving to the lowest neighboring value. Unknown walls are treated optimistically during exploration (assumed absent) and pessimistically during the speed run (assumed present).

Exploration Phase The robot dynamically detects its starting corner, then loops: read IR sensors → update wall map → re-flood → move to lowest neighbor. Exploration ends only when an optimistic and pessimistic flood both return the same distance to start — guaranteeing the shortest path is found. If not, it backtracks to fill gaps.

Speed Run Phase Using the saved maze, the robot runs the optimal path at full speed. It detects straight corridors and blasts through multiple cells in one motion call. Speed scales up 10% after each successful run, so the robot gets faster lap by lap.

Motion Control Dead-reckoning via wheel encoders with a PID controller. Uses a trapezoidal velocity profile (accelerate → cruise → decelerate). A PD steering controller balances left/right encoder deltas to keep straight. IR front walls and side-wall transitions correct drift at cell boundaries. Fixed-angle spin maneuvers handle 90° and 180° turns.

Maze Storage A flat 256-byte array encodes the full 16×16 grid. Each byte packs wall presence and observation status (known/unknown) for all four directions.

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