EM Engineering Club
UQ MARS Micromouse 2026 Report

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Acknowledgements

We thank the UQ MARS team for organising the Micromouse competition and for allowing non-students to participate. Opportunities to compete in robotics challenges after university are limited in Australia, and we greatly appreciate being included.

We also thank the team for providing a high-quality Micromouse kit, which significantly improved the learning experience and reduced setup time.

Overview

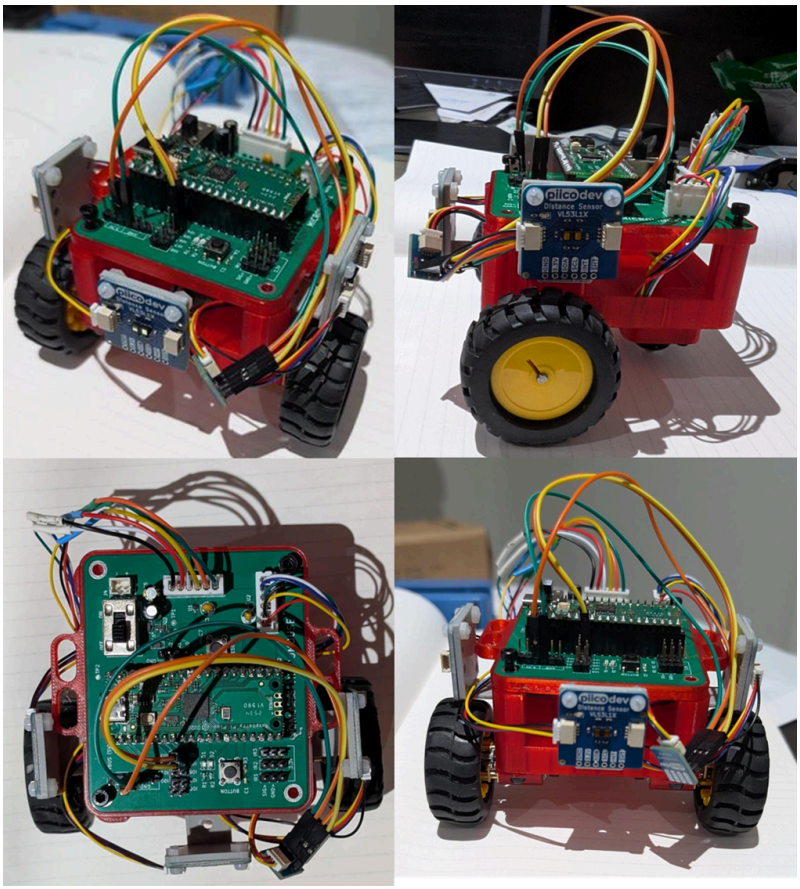
This report documents the design of two robots developed by the EM Engineering Club for the **UQ MARS Micromouse 2026**, held on **8 February 2026**.

This document covers the design and implementation details of each robot.

Video

https://youtu.be/1biOx0Q3veI

Robot 1 Design – UQ MARS Kit-Based Robot



Source Code

The most up-to-date source code is available at:
https://github.com/riku-ohyea/EMEC-micromouse/tree/main/02%20test%20hardware%20code/09%20MM%20DRIVERS/0207_bonk_test3

Minor tuning or adjustments may be made on the competition day. The latest commit on the team GitHub repository should be considered the final version used.

Design

Hardware

- Based on the standard UQ MARS Micromouse kit
- IR obstacle sensors were replaced with three I2C Time-of-Flight (ToF) distance sensors

- An I2C multiplexer is used to allow all three ToF sensors to operate on the same bus

Software

- Uses a basic flood-fill algorithm to assign cost values to maze cells
- The robot selects the lowest-cost path based on currently known walls
- ToF sensors are positioned to detect:
    - Left wall
    - Right wall
    - Front wall
- Sensors are limited to detecting walls in the current cell only
- A PIO-based encoder reader is used to reliably read encoder values at higher motor speeds

Control

- Encoder-based PID motor control (no integral term)
- Encoder-based PID used for:
    - Forward movement to the next grid cell
    - Heading correction and turning
- ToF-based PID used for heading correction when side walls are confidently detected
- A backing manoeuvre is used when a rear wall is detected, allowing the robot to correct heading using its flat rear surface

CAD

- Main chassis: https://github.com/uqmars/starter-micromouse/tree/master/CAD
- ToF sensor holders (×3): https://github.com/riku-ohyea/EMEC-micromouse/blob/main/05%20custom%20hardware/tof_holder_v01.stl

Circuit Schematics

- Main schematic: https://github.com/uqmars/starter-micromouse/blob/master/PCB%20Design/Schematic.pdf
- The I2C multiplexer with three connected ToF sensors is wired to:
    - 3.3V
    - GND
    - GPIO 4
    - GPIO 5
- Original obstacle sensors were removed from the circuit

Prices of Components

Name	Type	Material	Qty	Cost	Subtotal	Link
Top Plate 3D Print	3D Printed	PLA	1	-		
Base Plate 3D Print	3D Printed	PLA	1	-		
Motor Clamp 3D Print	3D Printed	PLA	2	-		
Caster Ball Extension 3D Print	3D Printed	PLA	1	-		
PiicoDev Laser Distance Sensor VL53L1X	Purchased		3	$18.85	$56.55	Core Electronics
N20 Motor with Encoder (6V 100RPM)	Purchased		2	$9.33	$18.66	Aliexpress
N20 Motor 43mm Wheel	Purchased		2	$1.60	$3.20	Aliexpress
Caster Ball	Purchased		1	$0.50	$0.50	Aliexpress
M3 x 8mm Hex Button Screw	Purchased	Stainless Steel	15	$0.10	$1.50	Aliexpress
Polymer Lithium Ion Battery (LiPo) 3.7V 1100mAh	Purchased		1	$8.95	$8.95	Core Electronics
USB-C Lipo Charger	Purchased		1	$7.60	$7.60	Core Electronics
Raspberry Pi Pico	Purchased		1	$3.89	$3.89	Aliexpress
JST XH 6-Pin Male/Female Pair (straight)	Purchased		2	$0.33	$0.66	Aliexpress
JST PH 2-Pin Male PCB Connector (straight)	Purchased		1	$0.02	$0.02	Aliexpress
PiicoDev Adapter for Breadboards	Purchased		1	$1.65	$1.65	Core Electronics
Adafruit PCA9546 4-Channel I2C Multiplexer	Purchased		1	$7.75	$7.75	Core Electronics
Micromouse PCB Assembly	Internally Manufactured		1	-		
16 X 7.8 X 10.5 MM, 6 MM RAISED	Purchased		1	$0.98	$0.98	

20V 2.4A 140M@4.5V,2.4A 900MW 1.	Purchased		2	$0.10	$0.20	
40V 550MV@2A 2A SOD-123FL	Purchased		1	$0.11	$0.11	
12-V, 1.76-A BRUSHED DC MOTOR DR	Purchased		2	$0.70	$1.40	
RES 10K OHM 5% 1/16W 0402	Purchased		2	$0.00	$0.00	
RES 100K OHM 1% 1/16W 0402	Purchased		1	$0.00	$0.00	
RES 220 OHM 5% 1/16W 0402	Purchased		2	$0.00	$0.00	
CAP CER 0.1UF 50V X7R 0603	Purchased		3	$0.02	$0.06	
LED GREEN CLEAR SMD	Purchased		1	$0.16	$0.16	
LED RED CLEAR SMD	Purchased		1	$0.21	$0.21	
				Total	$114.05	

Robot 2 Design – UQ MARS Kit-Based Robot

Still currently in development.

Appendix

Random Maze Generator

https://github.com/riku-ohyea/EMEC-micromouse/tree/main/Maze%20generator

A random maze generator was developed to assist with algorithm testing.
Current limitations:

- Requires further updates to integrate with the maze simulator used
- Can occasionally generate mazes with inaccessible regions