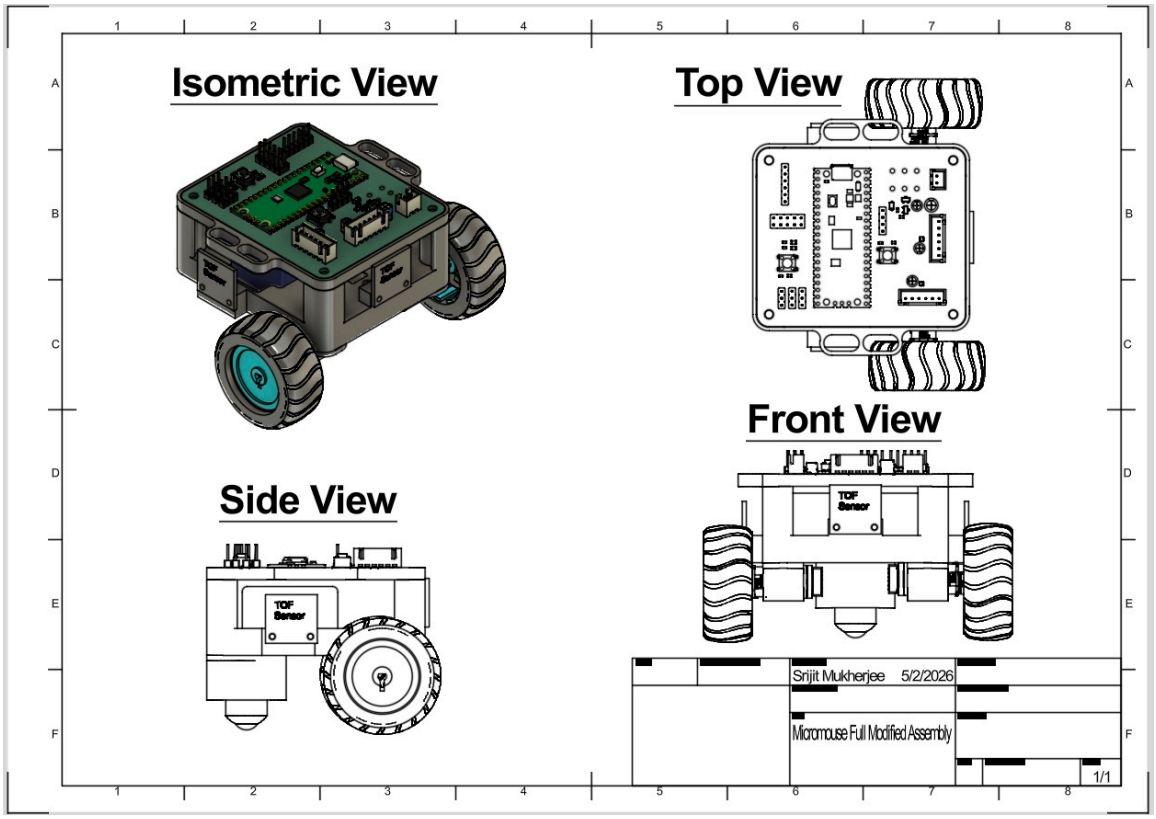
Context:
This PDF document contains documentation for the design of our micro-mouse. CAD models, PCB schematics and photos of the mouse and home-made maze are provided below. The bill of materials along with receipts are at the bottom of the document.

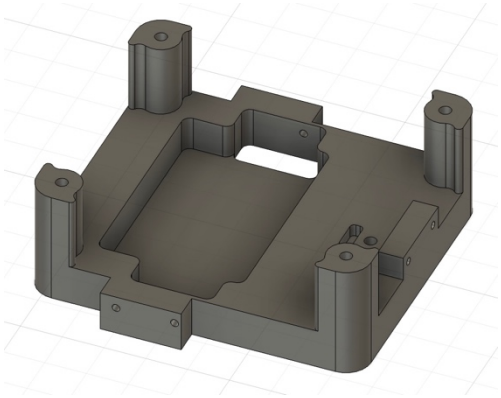
Micro-mouse CAD Models and Key Parts:
A CAD orthographic drawing of the full micro-mouse assembly is provided below:

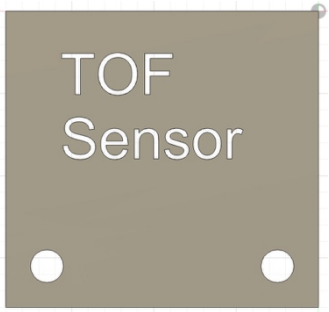


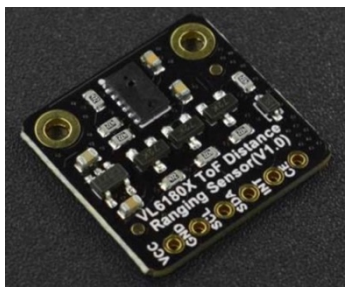
Overall, the mouse is almost identical to the kit provided by UQ MARS however, a few small changes have been made. These are:

- Using time of flight sensors instead of IR sensors for wall detection
- Making and 3D printing a different base plate to fit the time of flight sensors

Note that the new base enabled the TOF (time of flight) sensors to be attached using self-tapping M2 screws. This was the only modification to the original base plate.

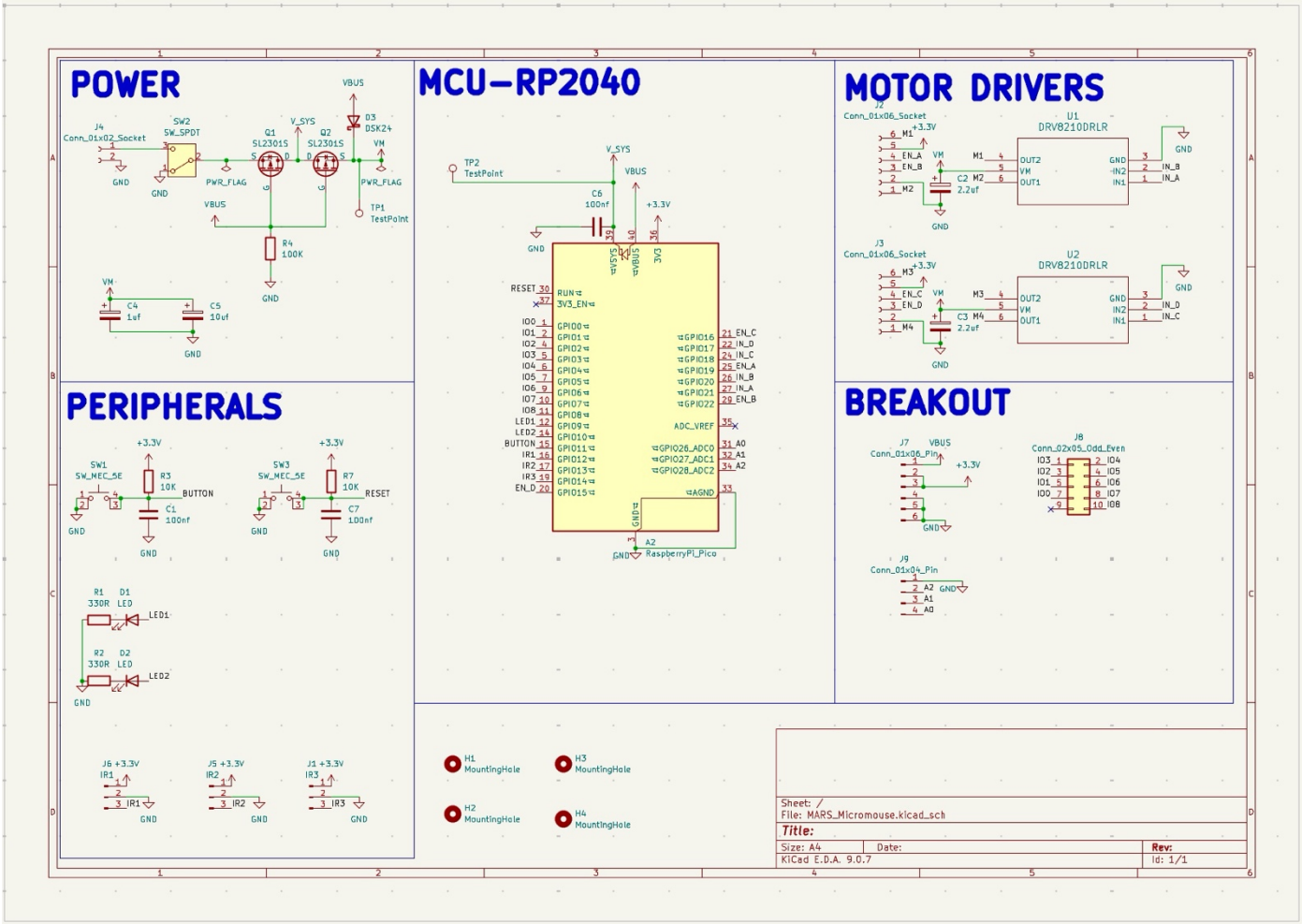


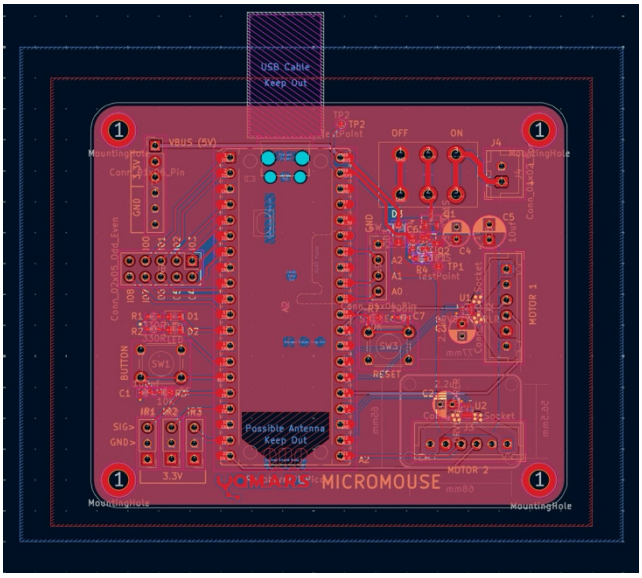


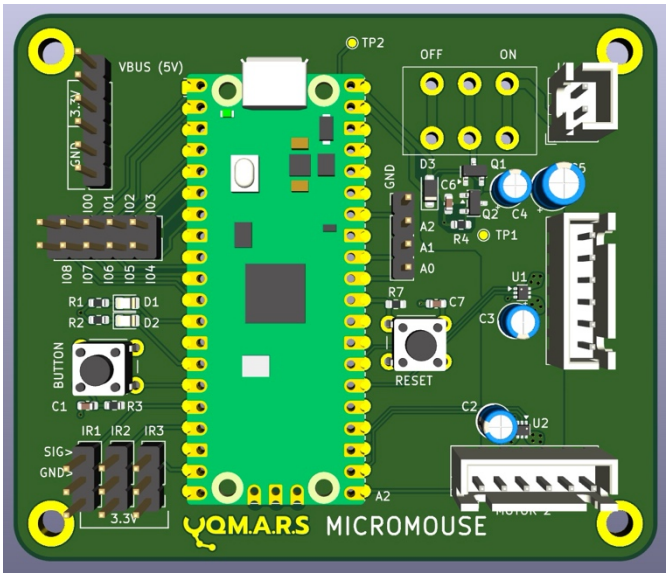


Electrical Schematics:

The electrical schematics for our micro-mouse are identical to the kit. The extra GPIO pins were used for the Time of Flight sensors. The left and right sensors were on the same I2C bus and the front time of flight sensor was on a separate I2C bus. The PCB schematic, routing and 3D view are all presented below.

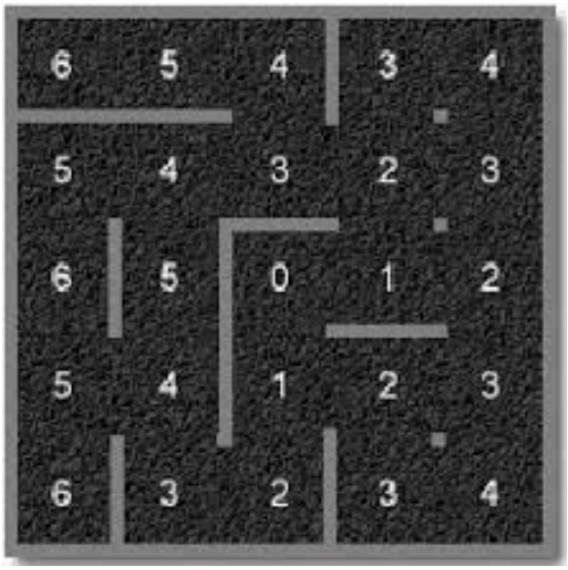


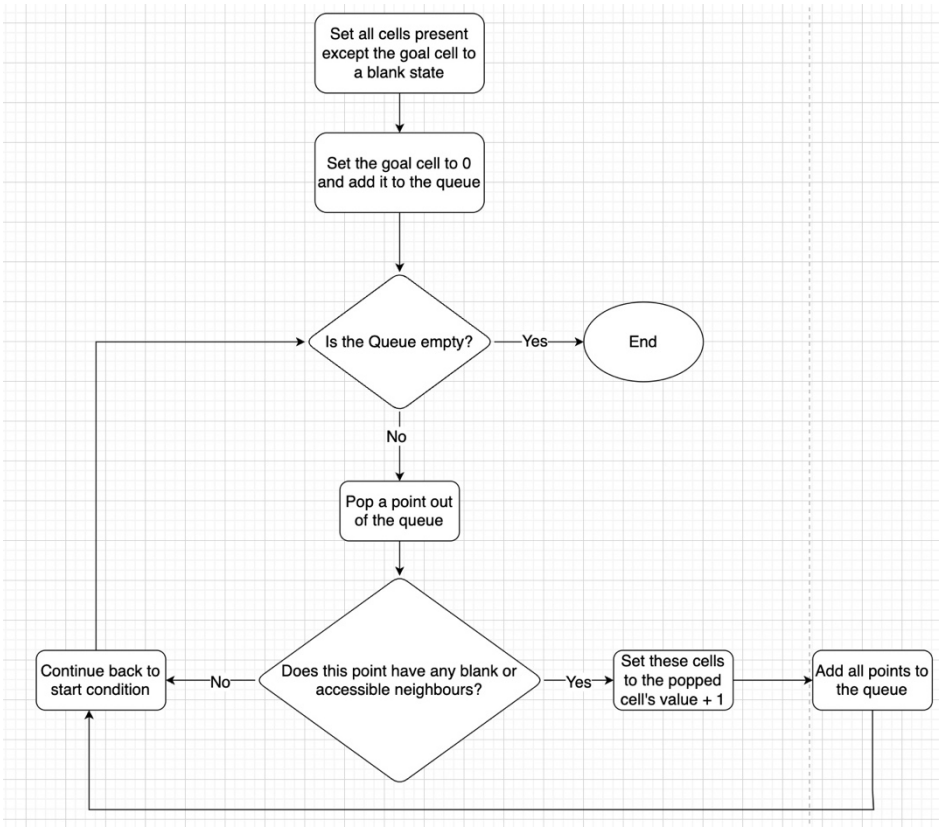




Programming Algorithms:
The key algorithm employed on this micro-mouse was the flood fill algorithm. The flood fill was the algorithm used to find the centre of the maze by updating walls as the mouse continues moving. The flood fill algorithm calculates the distances of each square to the maze based on the number of walls present. The centre or goal point has a distance of 0 for reference.

Initially, the mouse assumes that there are only outer walls along the boundary. Based on this, initial distances are established. As you can see in the maze below, the distances of each point to the centre have already been established. The flood fill function in our code calculates the maze distances, then the mouse continues to move to the square with a lower distance to the centre. The algorithm for calculating distances to the centre is provided in the algorithm flowchart below.



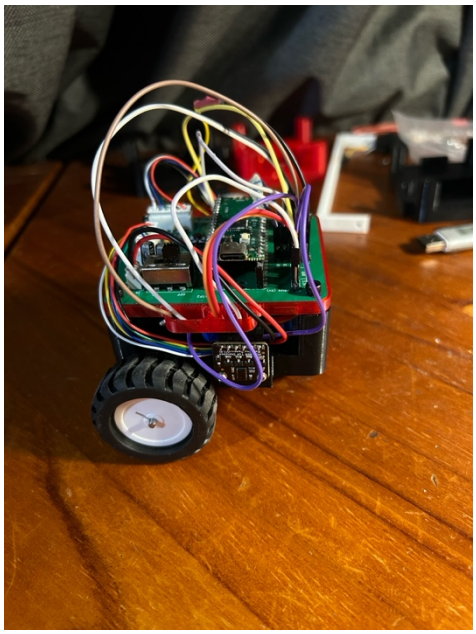
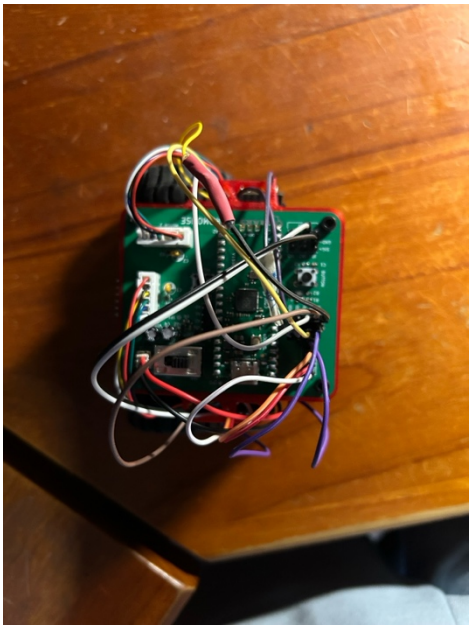
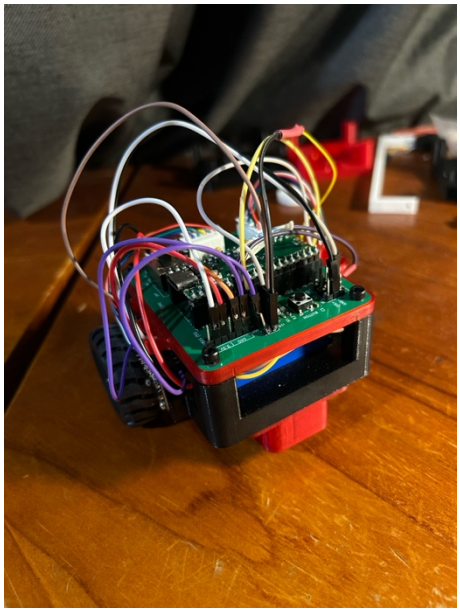


Now the mouse's overall logic works like this:
While mode == EXPLORE:
Search_centre() #The mouse is searching for the centre of the maze
Search_start_position() #The mouse returns to its start position using the same algorithm

Now within search_centre(), the logic is as follows move by move:
#At the very start calculate floodfill distances
Calculate_floodfill_distances()
sense_walls()
If the mouse then discovers an **accessible** neighbouring cell with a lower floodfill distance, it then moves there.
If the mouse cannot move to a lower floodfill distance neighbouring cell, it runs calculate_floodfill_distances() again and a lower distance cell is then found.

This decision making loop continues until the mouse's position is at the centre of the maze.

Photos of the Mouse:
Some photos of the actual mouse are provided below:

Maze Photo:

A 5x5 maze was constructed using MDF wood for testing. The 5x5 maze did try to replicate the dimensions of the actual maze by using 12mm MDF wood and keeping cell lengths 18cm and passageway widths 16.8cm.

Cost Spreadsheet:

Name	Type	Material	Qty	Cost	Subtotal	Link
Micromouse PCB Assembly	Internally Manufactured		1	-		
Top Plate 3D Print	3D Printed	Red PLA	1	-		
Base Plate 3D Print (Modified from Kit)	3D Printed	Black PETG	1	-		
Motor Clamp 3D Print	3D Printed	Red PLA	2	-		
Caster Ball Extension 3D Print	3D Printed	Red PLA	1	-		
Fermion VL6180X Time of Flight Sensor	Purchased		3	$12.60	$37.80	https://core-electronics.com.au/fermion-vl6180x-tof-distance-ranging-sensor-breakout.html
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
3.7V 1S 2000mAh LiPo Battery	Purchased		1	$15.30	$15.30	Core Electronics
USB-C Lipo Charger	Purchased		1	$7.60	$7.60	Core Electronics
Raspberry Pi Pico	Purchased		1	$3.89	$3.89	Aliexpress
					$88.45	

Receipts:
The relevant Receipts have been provided below:

Your payment includes the following items:

Receipt from UQ MARS

Item description	Qty	Unit price	Sub total
Workshop Attendence + Tutorial Micromouse	1	$40.00	$40.00
		Total AUD	$40.00

Print All Invoices

Invoice #1000609437 Print Invoice

Product Name	SKU	Price	Qty Invoiced	Subtotal
Fermion: VL6180X ToF Distance Ranging Sensor (Breakout)	SEN0427	$12.60	3	$37.80
			Subtotal	$37.80
			Shipping & Handling	$13.36
			Included GST	$4.65
			Grand Total	$51.16