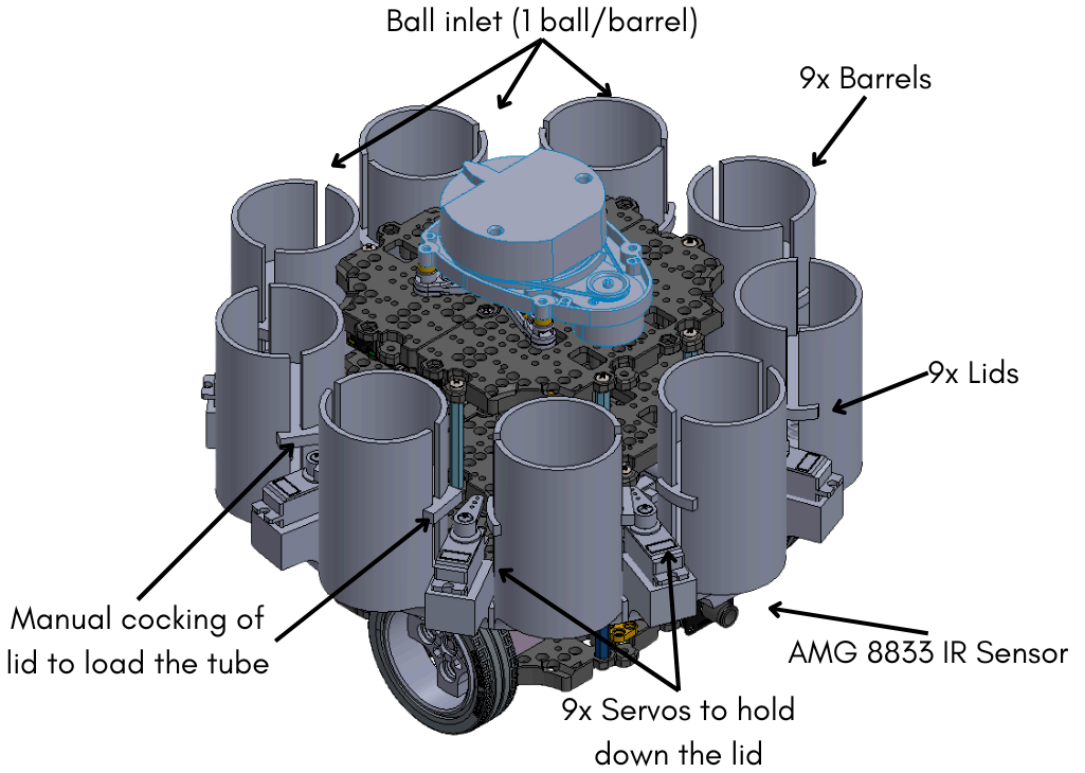
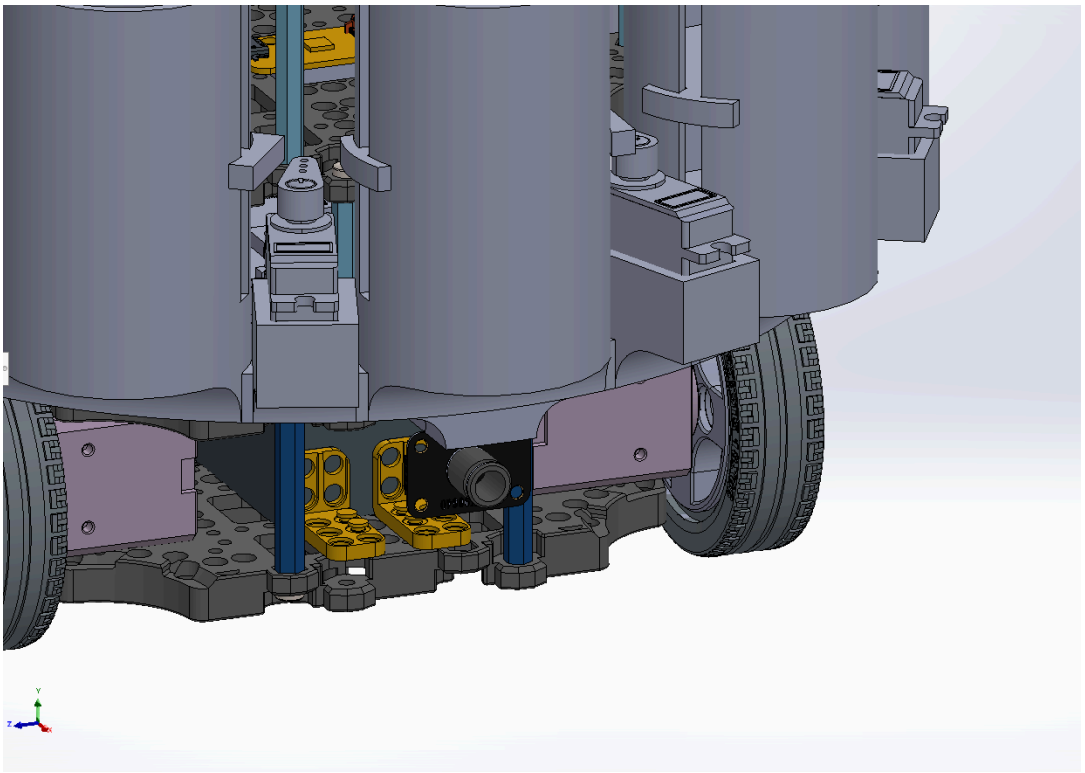
CDE 2310 Group 3 Turtlebot 3 User Guide

CAD File





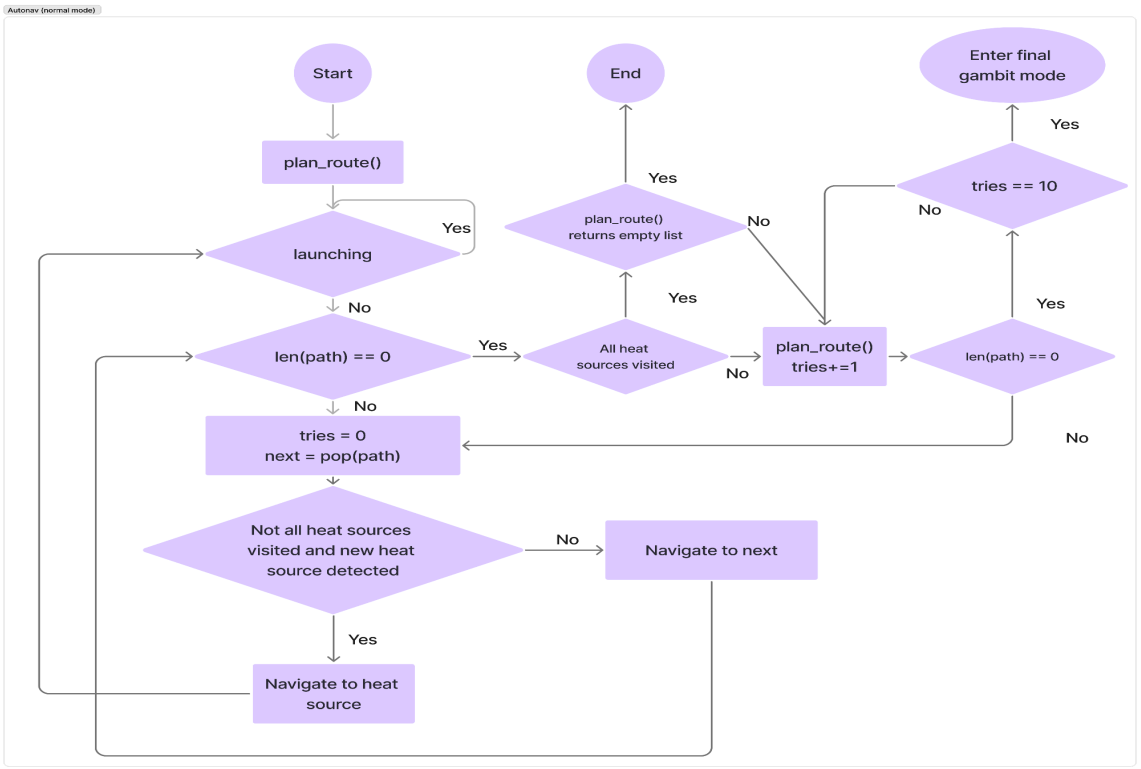
Technical Details

Technical Components	Details
Model	TurtleBot3 Burger ICBM V1.2
Software Version	1.4.7
Weight	1606.63g
Battery capacity	Lithium polymer 11.1V 1800mAh / 19.98Wh
Max Runtime	1.5 - 2 hours
Charging time	~2.5 hours
Purpose	1. To autonomously navigate the maze and avoid obstacles 2. Successfully find 3 heat signatures 3. Launches ping pong balls at predetermined intervals when heat signature found

Subcomponents

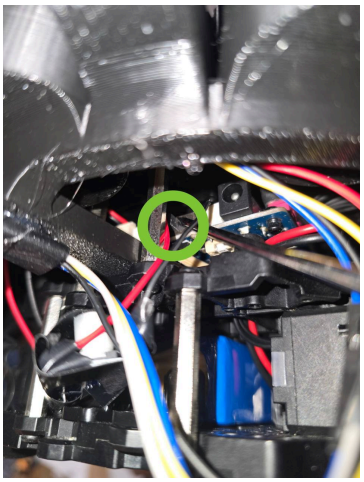
- Turtlebot 3
    - LiDAR
    - RaspberryPi
    - OpenCR1.0
    - 2x Dynamixel motors
    - LiPo Battery
    - USB2LDS
- Launch mechanism
    - Launch Tubes (Barrels) and Servo Housing
    - Adafruit PCA9685 16-Channel Servo Driver
    - 9x servos
    - 9x springs
    - 9x lids
    - LM2596 DC-DC converter
- AMG8833 IR Sensor

Software Diagram



User Guide

Turning on the TurtleBot



Recommended: use a screwdriver or a pen to poke the switch (circled in green) from underneath.

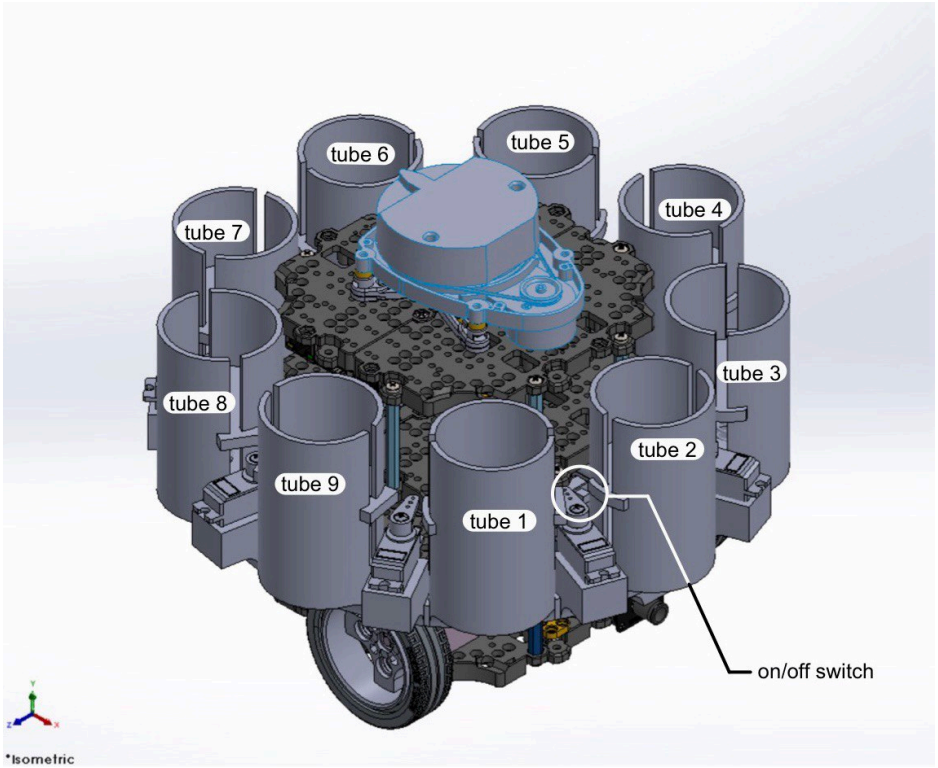
Reloading

[Raspberry Pi]

1. Run ‘python3 reload.py’
2. Choose which tube to reload (1 to 9, -1 for all)
    a. Servo arm for each specified tube should move into firing position (in line with servo body)
3. Cock tube
    a. Press and release the lid multiple times to check the smoothness of the launch tube

b. Ensure loading starts from servo 1
c. Press the lid down until it is below the servo arm (support the structure while pressing down to avoid it breaking)
d. Press “Enter” once mechanism cocked to lock servo arm into ready position (flush against tube)

4. If loading all servos, repeat steps 2-3 in the anti-clockwise direction until all tubes cocked
5. Load ping pong balls into all tubes
6. Conduct a final visual check on the lids of the tubes to ensure they are cocked properly



Calibration

[Raspberry Pi]

1. Run ‘ros2 run ircam ircam_on’
2. Move the robot around the maze without any heat source and take note of the maximum temperature in the maze
3. Enter ircam by running ‘cd /ircam_ws/src/ircam/’
4. Open ‘ircam.py’ and edit the variable ‘ambient’ to 1 degree above maximum temperature in the maze
5. Stop the ircam program with ‘Ctrl+C’
6. Change directory back to ircam_ws with ‘cd ~/ircam_ws’
7. Build the package with ‘colcon build’
8. Source the package with ‘source install/setup.bash’

Startup

[Remote PC]

1. Run cartographer
2. Run ros2 run auto_nav r2auto_nav

[Raspberry Pi]

1. Run rosbu

Factory Check

1. All components in place
    a. Refer to the subcomponents list
2. No loose components or wires
3. After startup:
    a. LiDAR spins
    b. OpenCR powered (check LED)
    c. RaspberyPi powered (check LED)
    d. Servo driver, DC-DC converter, USB2LDS working (LED)
    e. Servos functional (run ‘python3 reload.py’ to check they turn correctly)

Acceptable Defects

The support for the launch tube and servo housing structure broke, it is glued back and reinforced with wooden chopsticks.

User Maintenance

Date	Incident	Consequences	Rectification	Remarks
13 March 2025	RPi Power Input connected to OpenCR 12V output	RPi Burnout	Replacement of entire RPi	Ensure all wires are plugged into the correct ports before turning it on
		OpenCR Fused	Replacement of OpenCR 5A fuse	
3 April 2025	Servo housing broke when removing servo	Number of usable servo housings fell below minimum required to shoot 6 balls	Reprinting of the whole launch piece as the servo housing is built into the design	Costly design error, need to check tolerances before printing
3 April 2025	LM2596S in contact with metal strut	RPi intermittently shutdown	Covering of exposed metal contacts on components with electrical tape	Ensure electrical components are not in contact to prevent short circuits
5 April 2025	SG90 Servo locked in position	SG90 Servo Motor Burnout	Replacement of burned servo	NIL
		Complete destruction of servo during extrication from servo housing		
8 April 2025	Support broke	Stability of Launch mechanism compromised	Glued support back onto launch mechanism, reinforced with wooden chopsticks	NIL