EG2310 Group 5 End User Documentation

Robot System Name: S/Ue

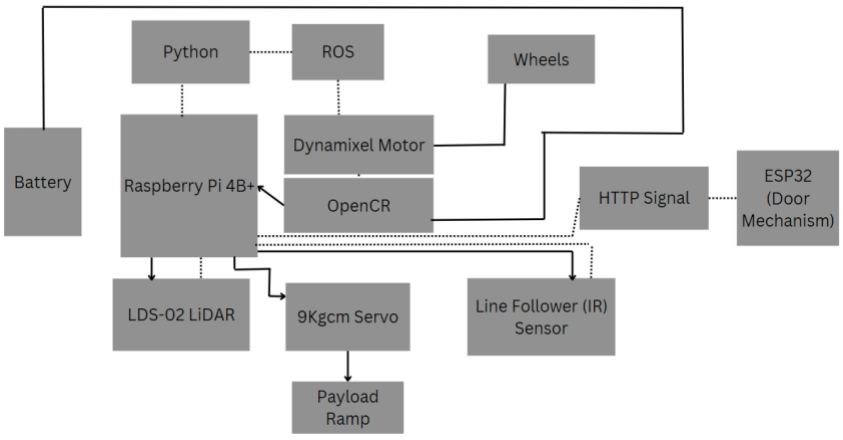
Section 1: General System Description & Critical Data

S/Ue is a modified TurtleBot 3 Burger designed to navigate through a maze, identify & unlock a door through an HTTP call, and then locate a bucket on the other side of the door. S/Ue will then release 5 ping-pong balls into the bucket, and proceed to re-enter the maze to develop a map using SLAM.

Hardware Specifications

	Details	Specifications	Notes
TurtleBot	Model	TurtleBot 3 Burger	
	Dimensions (mm) Length x Width x Height	138 x 178 x 192	
	Weight (g)	9	
	Max. Velocity	0.22 m/s	
	Line Sensors	Uses TCRT5000 IR sensor	Uses M393 comparator
Payload	Dimensions(mm) Length x Width x Height	103 x 87.5 x 173	
	Weight (g)	501g	
	Servo Motor	MG995	
System	Center of Gravity (mm)	Origin: Below the bottom plate's back right support pillar **Centre of gravity : (-57,159,70)**	
	Battery Capacity LiPo Battery	11.1V, 1,800mAh	
	Battery Life	2h 30m	
	Communication Interface	GPIO, I2C	

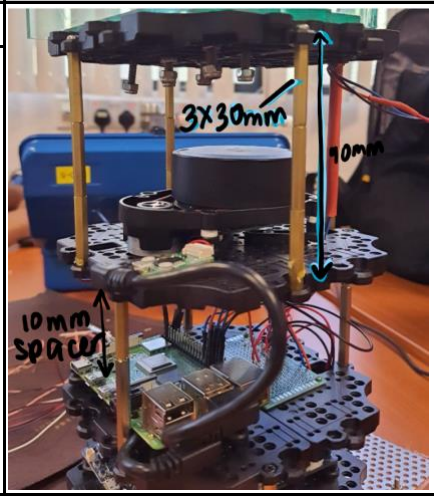
Hardware Block Diagram

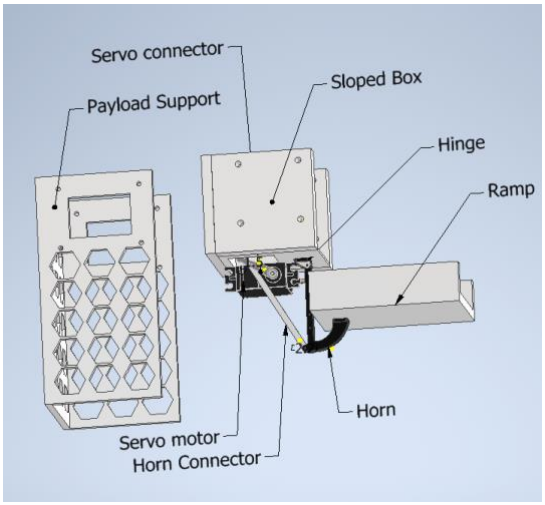


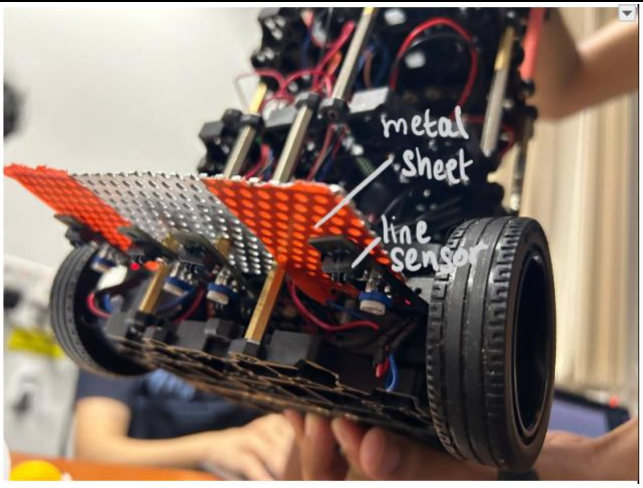
Assembly Instructions

The TurtleBot 3 itself was assembled using the ROBOTIS official manual, with the following modifications:

- 2x additional **waffle plate** layers
- **Line sensors added** to second layer for line follower subsystem
- An additional 90mm height was added between the 4th and 5th waffle plates, using 12x 30mm spacers. 4 x 10mm height added between 3rd and 4th waffle plate

TurtleBot 3		
Item	**Qty**	**Image**
30mm spacer	12	
Waffle plate	2	

Payload		
Item	**Qty**	**Image**
Payload support	1	
Payload support base	1	
Payload sloped box	1	
Payload Ramp	1	
Horn	1	
Servo	1	
Servo arm	1	
Hinge	1	
Horn Connector	1	

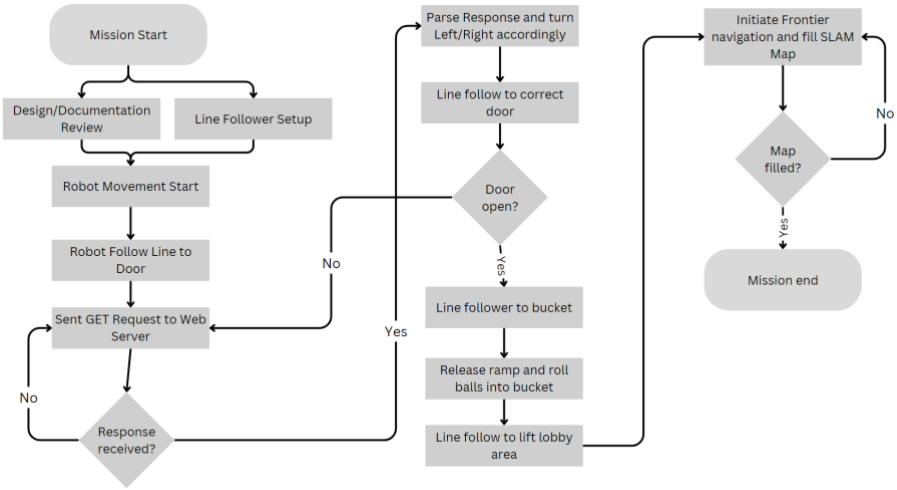
Line Sensors		
Item	**Qty**	**Image**
Metal sheet	1	
Line Sensors	4	
M3 Screw and Nut	4 each	

Technical Guide

Methodology

S/Ue starts the mission by **line following through the maze**, up to the 'lift lobby section', where it will stop and **send an HTTP request to a web-server,** which will open one of two doors. Next, S/Ue will **line follow through the correct door and towards the bucket**. S/Ue will then **activate its payload**, and release the ping pong balls from the ramp. Finally, S/Ue will **line follow back towards the lift lobby,** then **proceed with frontier-based exploration to explore and map** the remaining unexplored sections of the maze.

Flow of Events



Pre-Mission Setup(Map)

1. Lay tape marking a direct shortest path through wide areas from the start line to the lift lobby.

2. Lay tape routes from the lobby through both doors towards each respective bucket in the form of a T-junction

3. Lay a stretch of tape as a 'finish line' perpendicular to each path exactly 10cm from the bucket.

Mission Start

Prerequisite:

- S/Ue is positioned at start point
- Tape route is set up correctly
- Required software installed & setup

In the CLI (Ubuntu Bash terminal) input the following commands (both team's defined aliases & full commands have been given):

Window 1: `sshrp` => `rosbu`
Window 2: `toolbox`
Window 3: `rvm`
Window 4: `line`
Window 5: `exp`

Acceptable Defect Log

Defect	Classification		
	Minor	Major	Critical
Small gap at connection between base of payload and U-shaped support	X		
The payload horn has slight translational motion which affects the rigidity of the ramp as well, making it less stable and fixed	X		

Factory Acceptance Test

Component	Success Criteria	Testing Method
Raspberry Pi 4	Able to turn on when connected to OpenCR	Switch on OpenCR, RPi's red light should be on while green light flashes
	Remote laptop able to ssh into it	CLI enters the RPI's system when command `sshrp` entered
OpenCR	Able to be powered on by the LiPo battery	Green light lights up when connected to battery, and boot up tune played
LDS-02	Able to consistently read data	Environment mapped to RViz after running `toolbox` and `rvm`
Wheels & Ball-Caster	Able to move S/Ue in all directions	Manually control S/Ue's velocity by running `rteleop`
TCRT5000	S/Ue able to follow along predesigned route and turn/stop when required	Test line following capabilities by running `lineFollower.py`
Servo Motor	Able to open and close	Test payload capabilities by running `payload.py`
Overall Structure	Able to move, make turns, without toppling over and while maintaining at 3 points of contact to the ground	Manually control S/Ue's velocity and observe stability during motion by running `rteleop`
	All fasteners secured	Verify fastener tightness/installation and compare the count to the assembly document

Maintenance and Part Replacement Log

S/N	Defect Date	Qty	Component	Description	Rectification	Close Date
1	8/2/23	1	Raspberry Pi 4	RPi burnt	Replace with new RPi	9/2/23
2	14/2/23	1	Micro SD Card	SD card unable to be read	Replace with new SD card	14/2/23
3	4/4/23	1	Payload horn	Section glued together with epoxy and unable to open	Cut through epoxy to allow components to freely move	4/4/23