EG2310 GROUP 3 END USER DOCUMENT AND TECHNICAL LOG

1. General System Description and Critical Data

Purpose: The **Dispenser and Delivery Robot System** allows a can to be loaded, dispensed, and then delivered to a table chosen by the user.

1.1 Dispenser

The Dispenser allows the user to load a can, choose the table number for delivery. It then transfers the can to the Delivery Robot.

Model	Custom-made in-house
Overall Weight	1.64 kg
Overall Centre of Gravity w/o can (x,y,z)	(35.59, 82.25, 30.16)
Overall Dimension LxWxH (mm)	93x178x207
Power Specification	4x AAA Batteries

1.2 Delivery Robot

The Delivery Robot is designed to receive a ⌀66mm drink can of length 115mm, approx weight 350g from the Dispenser and delivers it to the table chosen by the user. The manufacturer does not guarantee the usability of this robot for cans of different dimensions and/or weights.

Model	ROBOTIS TurtleBot 3 Burger adapted with custom-made Drink Can Carrier Assembly
Software Version	Ros2 Foxy
Overall Weight	1.3kg
Overall Centre of Gravity w/o can (x,y,z)	(5.5,0,5.5)
Overall Dimension LxWxH (mm)	235x178x192
Power Specification	LiPo Battery 11.1V 1,800mAh

Refer to TurtleBot3 Burger Specifications found on ROBOTIS e-Manual website:
https://emanual.robotis.com/docs/en/platform/turtlebot3/features/#specifications

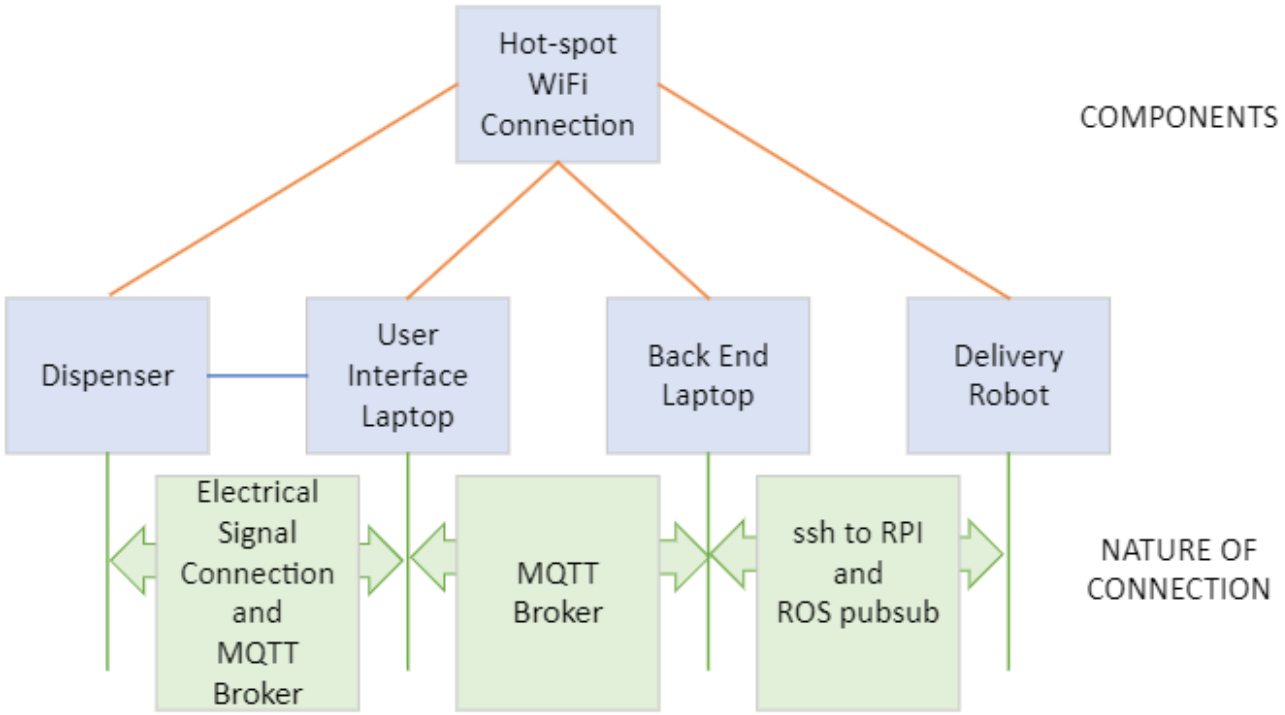
1.3 Instructions for User

1) Place Dispenser at the designated spot on the arena such that its **center is 50cm from the side wall** and the Electronics Platform is **flush to the back wall** of the designated spot.
2) Place the Delivery Robot in front of the Dispenser such that the **front of the LiDAR is facing the Dispenser** and the **V-shaping Homing Plate on Delivery Robot is inside the Dispenser's V-shaping Homing Plate**. **Do not press any buttons before this is done.**
3) Load the can in the Dispenser. Do not drop in the can, **place it lightly** in the carrier, **flushed close to the servo-side**.
4) Press the button labeled 'EN' on the ESP32 board.
5) Press the button on the keypad to indicate the table number. Do not press the button multiple times. You can only press table number 1-6 and each table can only be chosen once. If a table that has been chosen before must be chosen again, follow steps in **1.4**
6) Dispenser will load the can into the robot, and the robot will travel to the designated table. It may go near other tables, please wait until it reaches the desired table and the wheels have stopped rotating to pick up the can.
7) Collect the can after the robot comes to a full stop within 15cm of the designated table.
8) Wait for the Delivery robot to return to the dispenser and dock with the dispenser.
9) Repeat Steps 5-9 for subsequent tables.

1.4 Repeating a table

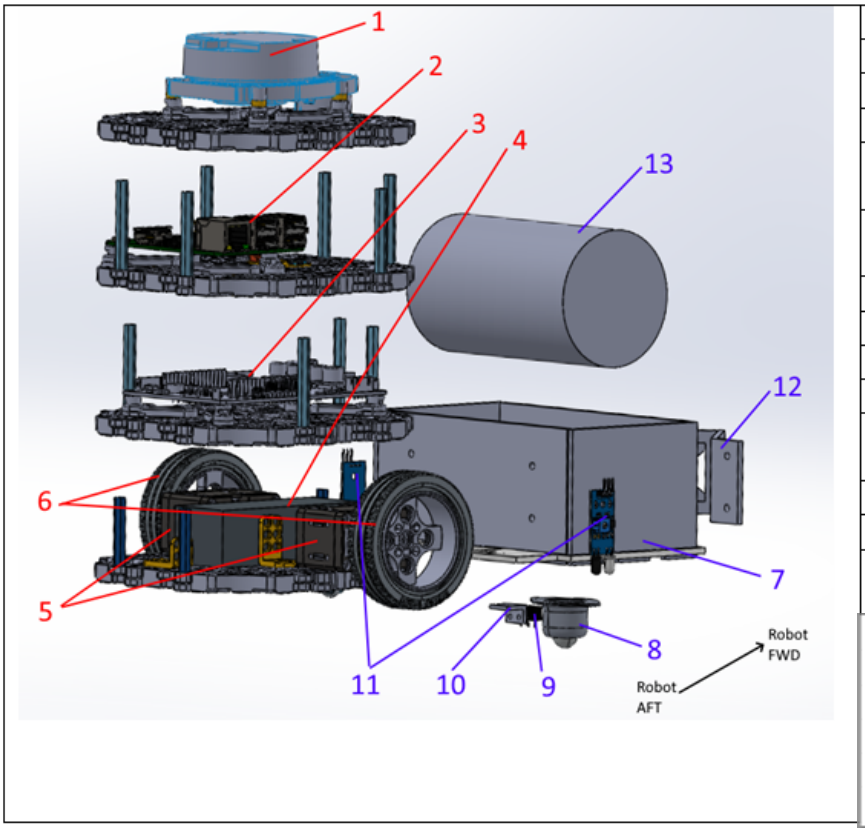
1) On the back-end laptop, press ctrl+C. Press the arrow up key and press enter.

1.5 Systems Communication Diagram



2. Assembly Document

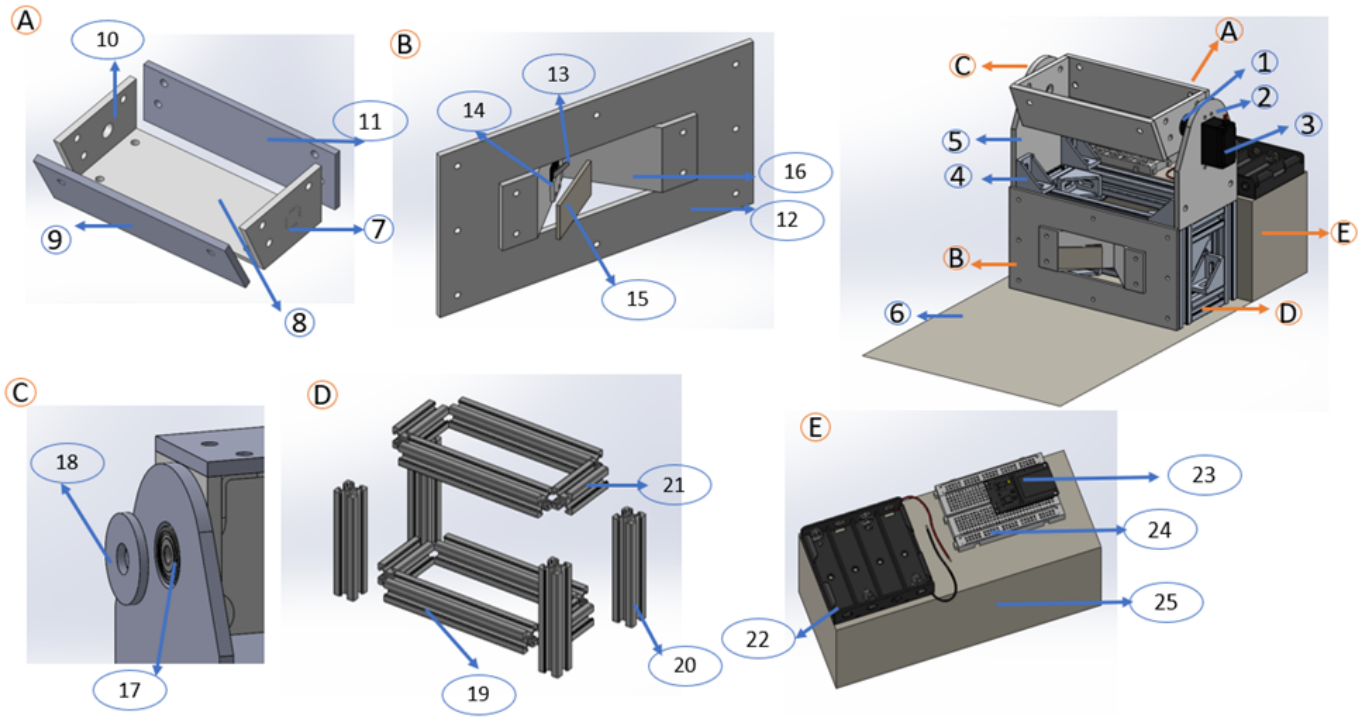
2.1 Delivery Robot



S/N	DESCRIPTION	QTY
1	Laser Dist. Sensor LDS-01	1
2	Raspberry Pi 3 Model B+	1
3	OpenCR 1.0	1
4	LiPo Battery 11.1V 1,800mAh	1
5	DYNAMIXEL Motor XL430-W250-T	2
6	Tyre, 66mm diameter	2
7	Acrylic Can Carrier	1
8	Ball Caster	1
9	Limit Switch	1
10	3D printed mount for Limit Switch	1
11	Infrared Sensor Module	2
12	V-shape Homing Angle	1
13	Can Drink (to be supplied by dispenser)	1

Refer to TurtleBot3 Burger Assembly Instructions found on ROBOTIS e-Manual website for Turtlebot assembly instructions. Mount the Can Carrier Assembly to the Turtlebot using 8x M3 screws.

2.2 Dispenser



No.	Part Name	QTY
1	Circular Servo Horn	1
2	Servo Side Support	1
3	MG996R Servo	1
4	2020 Angle Bracket	20
5	Bearing Side Support	1
6	Homing Platform	1
A	**Carrier Assembly**	
7	Servo Side Plate	1
8	Bottom Plate	1
9	Front Plate	1
10	Bearing Side Plate	1
11	Back Plate	1

B	**Homing Assembly**	
12	Homing Plate	1
13	Limit Switch	1
14	Limit Switch Mount	1
15	Homing Adapter	1
16	V-shape Homing Plate	1
C	**Bearing Assembly**	
17	Bearing 609 ZZ	1
18	Bearing Washer	1
D	**Profile Bar Assembly**	
19	2020 Profile Bar 50mm	4
20	2020 Profile Bar 98mm	4
21	2020 Profile Bar 138mm	4

E	**Homing Assembly**	
22	Battery Holder	1
23	ESP32	1
24	Breadboard	1
25	Electronics Platform	1

3. Acceptable Defect Log

3.1 Dispenser

Defect Description	Acceptable Criteria	Defect Classification		
		Critical	Major	Minor
Dispenser carrier has gaps between its faces	This does not pose any effects on its structural integrity, strength of holding the can, and general function		X	
Homing Angle has a cardboard piece taped inside	This serves to facilitate the homing			X
Profile bar base has slight misalignment	This does not affect its structural integrity			X
The nut for the bearing is a little lose	This is to ensure tolerancing for proper function of the roller bearing		X	

3.2 Delivery Robot

Defect Description	Acceptable Criteria	Defect Classification		
		Critical	Major	Minor
There is acrylic glue holding the plates of the Delivery Robot's carrier together but there are slight gaps	Tape is used to ensure the carrier is secure			X
LiDAR scanning is not accurate	We have calibration code to check that the LiDAR is operating correctly in relation to its surroundings.		X	

4. Factor Acceptance Test

4.1 Dispenser

Test Procedure and Objectives	**Acceptable Criteria**	**Acceptable (Y/N)**
Physical Checks		
Shake test	When the Dispenser is shook, no cables come loose, no parts fall out, no screws fall out	
Safety Check	No signs of damage on the cables Cables are routed neatly and are not in the way of the Dispenser Carrier's motion	
Common Ground	Ensure all components are connected to common ground	
Electronics Components Checks		
Connect a laptop with the Arduino IDE, running *'ESP32_final_mqtt_pub_test'* to the ESP32		
Verify Batteries are in working condition	Use multimeter to ensure batteries that the sum of the 4 AA Batteries sum to at least 4.8 V	
Verify that the limit switch works	Press down the limit switch. Serial Monitor on laptop screen should print 'Limit switch activated! Robot is here, waiting for	

	keypad input…'	
Verify that the keypad works	Press any key from 1 to 6. Serial Monitor on laptop screen should print 'Table number for delivery: [*keypad input*]'	
Verify that the Servo motor works	After the laptop screen prints 'Robot is receiving table number...', it should print 'Tilting…' and the servo should turn the Dispenser Carrier	

4.2 Delivery Robot

Test Procedure and Objectives	**Acceptable Criteria**	**Acceptable (Y/N)**
Physical Hardware Checks		
Shake test	When the Delivery Robot is shook, no cables come loose, no parts fall out, no screws fall out	
Safety Check	No signs of damage on the cables	
Turn on Delivery Robot	1. Green light on the OpenCR 2. Sequence of beeps in when Turtlebot is turned on 3. RPI Green Light is on	
Electronics Components Checks		
Verify that the RPi works	Sshrp to the RPI Terminal should return 'Welcome to Ubutntu [...]' RPI flashes a red light to show power is connected RPI flashes a green light to show SD card is being read	
Verify that the OpenCR works	Sequence of beeps when the delivery robot is turned on	
Verify that the Dynamixel motors work	Key in **ros2 run turtlebot3_teleop teleop_keyboard** The following commands can be used to observe that the movement is as expected W for forward S for Stop D for turning right A for turning left X for backwards	
Verify that the IR Sensor Module is operational	The IR sensor on one side should be light up green and the other side should light up red.	
Verify that the LiDAR is calibrated correctly	Key in **python3 r2lidar_calib.py** Key in '0' and place an object at the physical '0' degree of the LiDAR. The LiDAR should be logging a sudden decrease in distance (0.21), which indicates that the angle is calibrated. Repeat for 180 degrees, you should see the distance as 180 degrees	

5. Maintenance and Part Replacement Log

FOUND BY/DATE /TIME/SIGN	REASON PLACED UNSERVICEABLE	DETAILS OF ACTION TAKEN	DATE/ TIME	TRADESMAN NAME/SIGN
HANG JG 30/3/23 2030H	BATTERY UNABLE TO CHARGE.	BATTERY REPLACED.	30/3/23 2045H	HANG JG