Table Of Contents

1-Title Page:

SANDSTORM Team No# 1583 We are team Sandstorm in the WRO Future Engineers 2025 competition and we'd like to represent a robot with which we will hopefully reach the highest positions so we may represent our proud country globally and win for it!

Team members: 1- Abdulaziz Al-Nujaidi 2- Abdulaziz Al-Hussaini

Coach: Abdelrahman Fatouh

Team logo

Team Photo

2-Vehicle Design:

v1.0 Design:

About The v1.0 Robot Design:

We modified the RN AI robot chassis to suit our ideas, using ultrasonic sensors for better navigation, using a DC Motor for rear wheel drive, adding an LCD for debugging and changed the servo motor to a metal gear for better torque and steering accuracy. We also added an MPU sensor for tracking the YAW axis of the robot and use it to count the laps. For obstacle detection we used a pixy cam instead of a husky lens since it has image calibration and is proving much more efficiency in the game field.

Feedback:

- ultrasonic sensor is bad to work with
- Chassis is very bad and has a bad mechanism for the wheels and steering

Characteristics:

Dimensions:

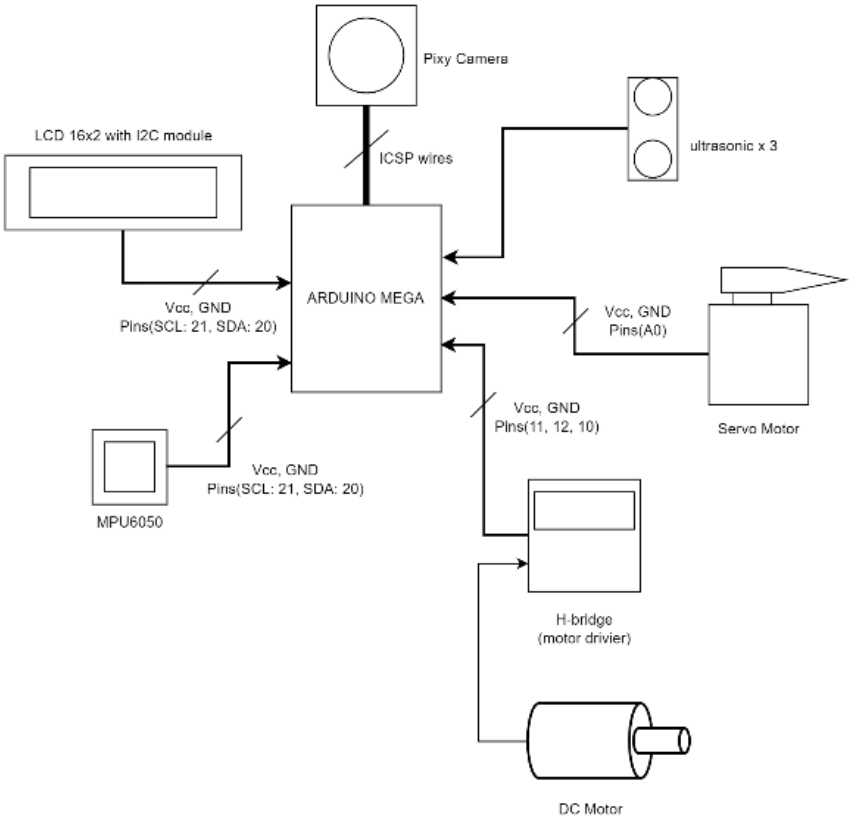
Height: 19 cm
Width: 16 cm
Length: 20 cm

Weight: 1030g

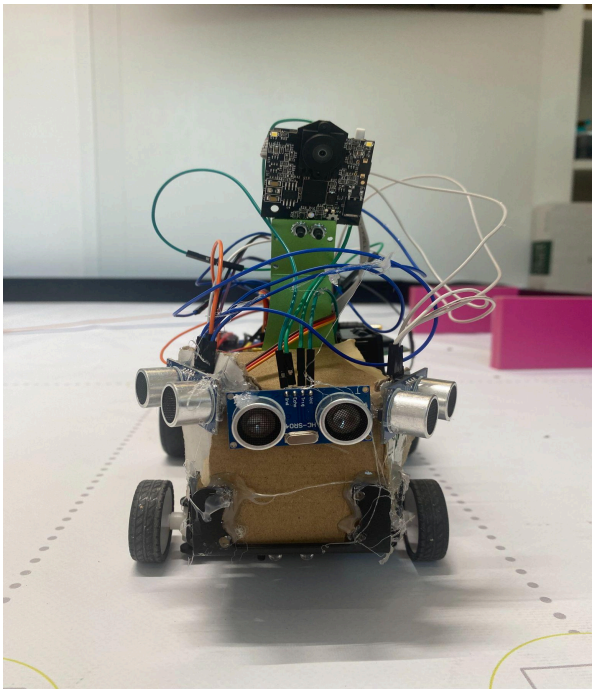
Bill Of Materials:

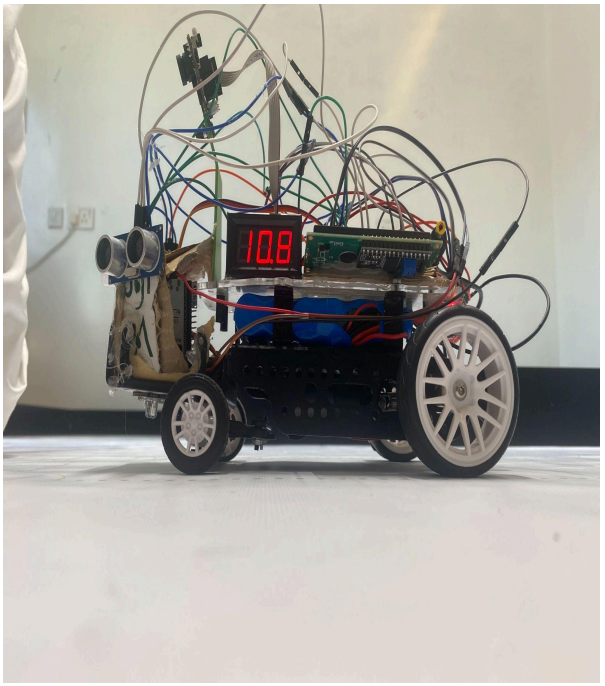
Object:	Price:
2 Big Back wheels	5 SAR
Battery	150 SAR
MPU6050	20 SAR
Pixy	400 SAR
H bridge	20 SAR
Structure	300 SAR
DC Motor	50 SAR
3 ultrasonic	10 sar per sensor
Kit of wires	20 SAR
LCD display	35 SAR
2 small front wheels	5 SAR
Arduino mega	120 SAR
Servo	25 SAR
Voltmeter	15 SAR
Total amount:	1195 SAR

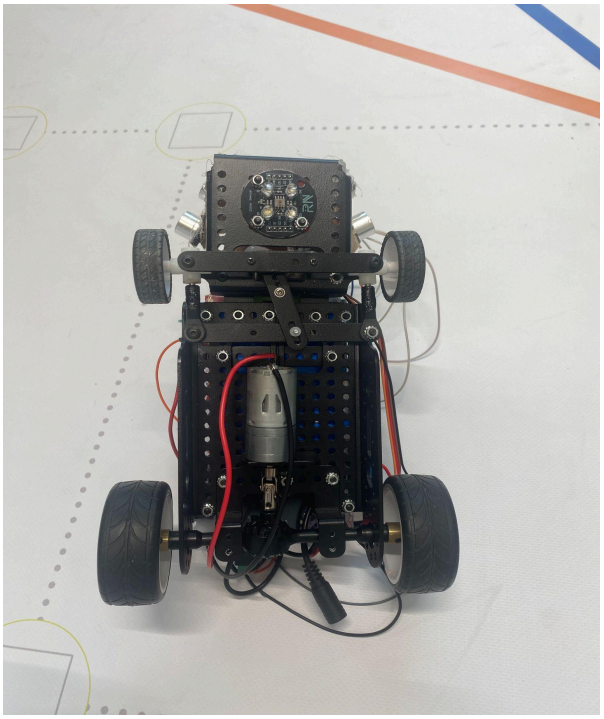
The Circuit Diagram

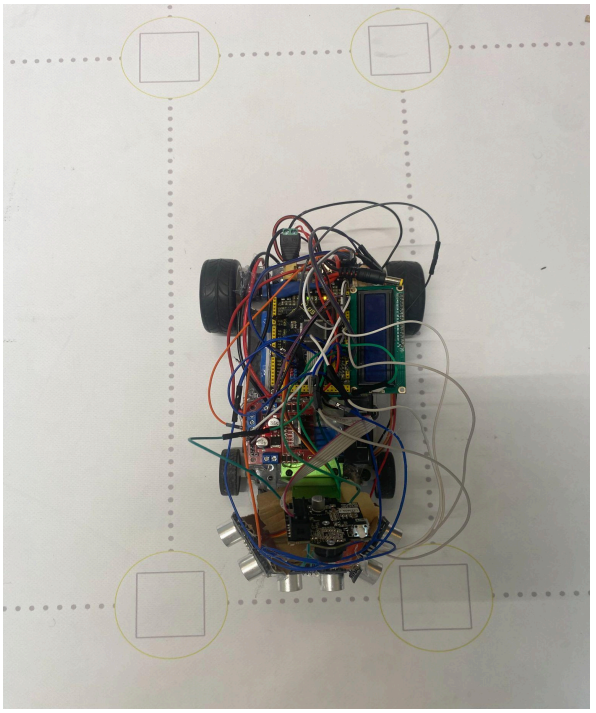


Robot photos









v2.0 Design :

About The v2.0 Robot Design (Mobility and power and sense management):

We have built this design from scratch, we've used a Creality K1 Max 3D printer to print the whole structure and mounting by PLA + for a customized mechanism, a Raspberry pi 5 for its high capabilities and its high image processing, got rid of the ultrasonic sensors and used a webcam instead of pixy for more accurate and efficient obstacle detection, used two more batteries due to increased power consumption, and we've removed the MPU to reduce power consumption used lines counting by the cam to count the laps.

Feedback:

- Counting laps by counting lines is not reliable

Characteristics:

Dimensions:

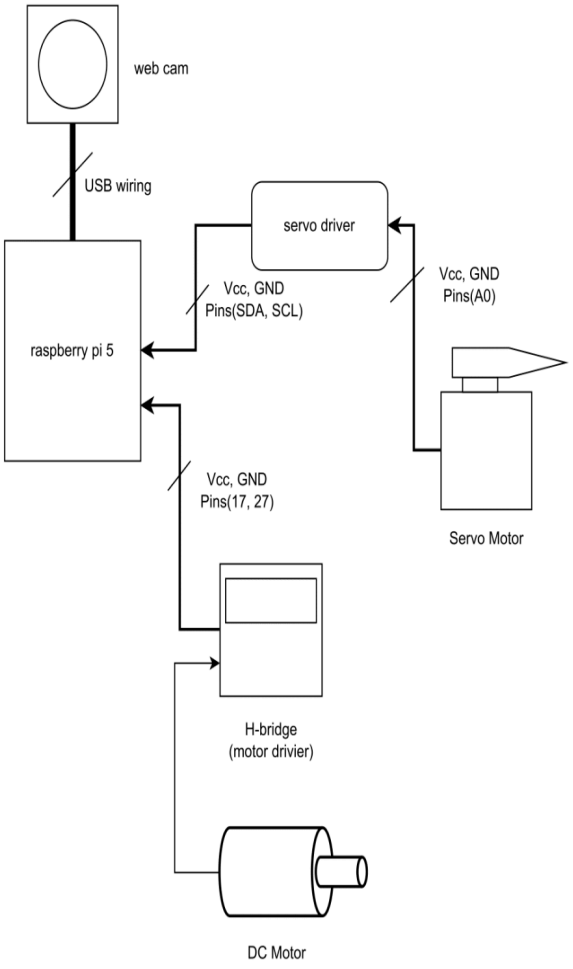
Height: 17 Cm
Width: 11 Cm
Length: 16 Cm

Weight: 911 g

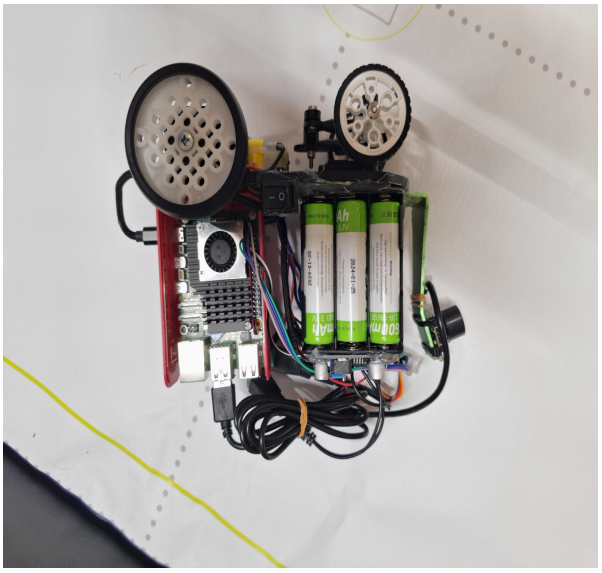
Bill Of Materials:

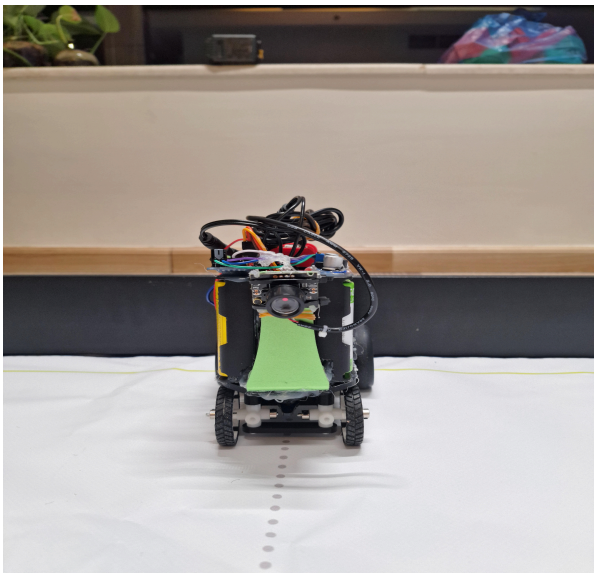
Object:	Number of pieces:	Price Per Piece:	Total price:
Pla+	500 gram	100 SAR Per Kilo	50 SAR
Small Front Wheels	2	3 SAR	6 SAR
Big Back Wheels	2	5 SAR	10 SAR
Dc motor: 6v, Tshape	1	10 SAR	10 SAR
Servo motor: mg995	1	20 SAR	20 SAR
Lithium Batteries	6	20 SAR	120 SAR
Raspberry pi 5	1	450 SAR	450 SAR
Step Down transformer: DC	1	10 SAR	10 SAR
Hbridge: L298N	1	20 SAR	20 SAR
Battery Case	2	3 SAR	6 SAR
Screw & Nut Kit:	1	30 SAR	30 SAR
WebCam	1	100 SAR	100 SAR
Servo Driver	1	25 SAR	25 SAR
Kit of Wires	1	10 SAR	10 SAR
Total amount:			867 SAR

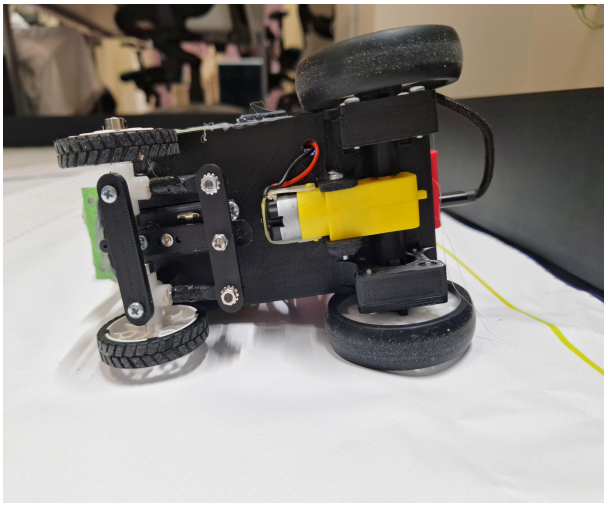
The Circuit Diagram:

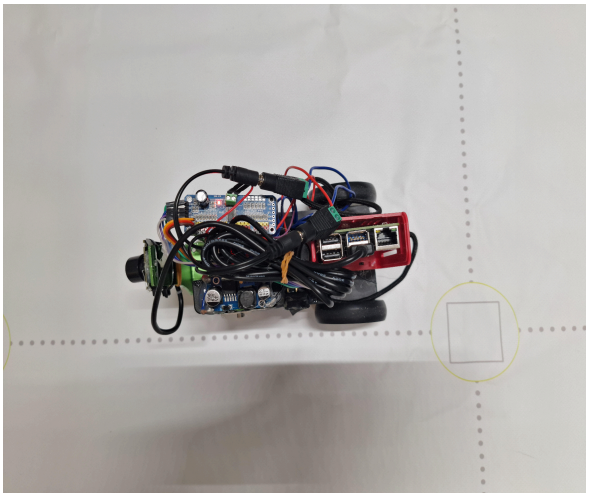


Robot Photos:









V3.0 Design :

About The v3.0 Robot Design:

We used our own 3d structure and mounting since we customised it to perfectly suit our design and kept the DC motor since it proved efficient in the national finals, we replaced the mg 995 servo motor for an mgDS 3240 for a stronger torque of 40 kg per cm. We added a Gyro for accurate readings of the angle of the direction of the robot in order to count the number of laps and to avoid obstacles accurately, continued using the webcam for efficient image processing, we kept using 6 lithium batteries as a power source and placed two pairs of them in parallel to double the amperes of the circuit so we don't have to worry about power consumption and we made the front wheels smaller than the back wheels for more controlled rotation.

Characteristics:

Dimensions:

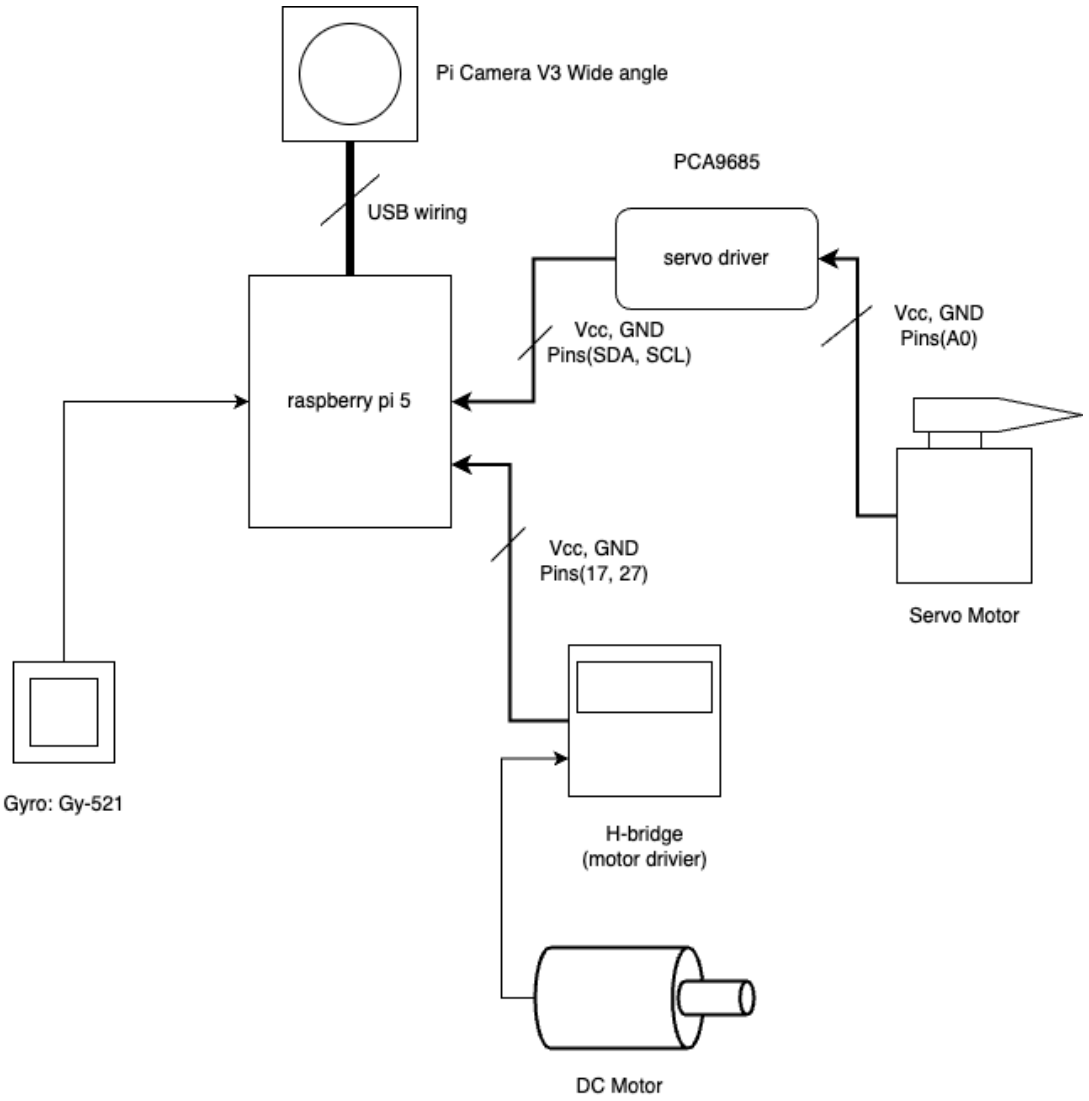
Height: 19 Cm
Width: 11 Cm
Length: 21 Cm

Weight: 935 g

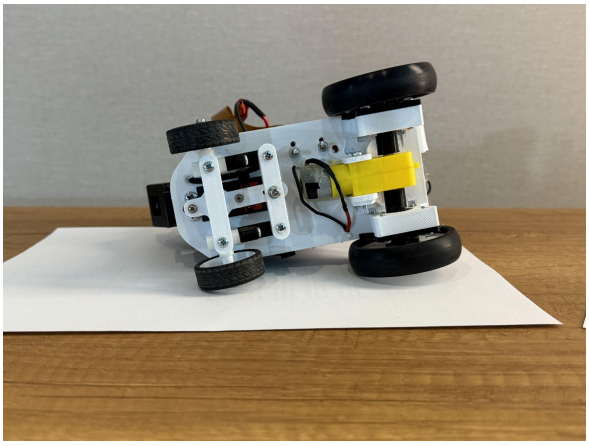
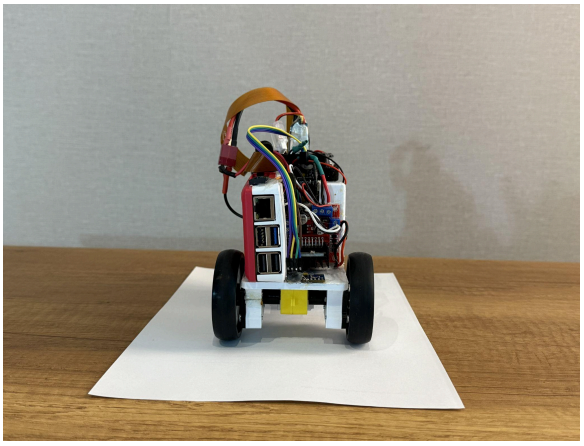
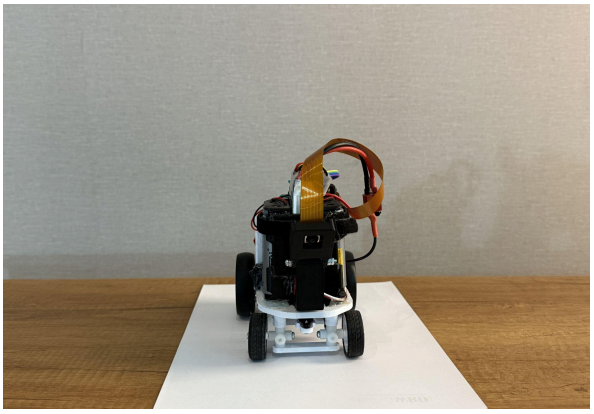
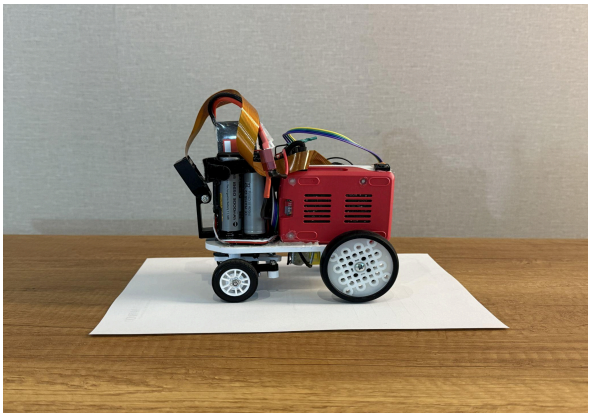
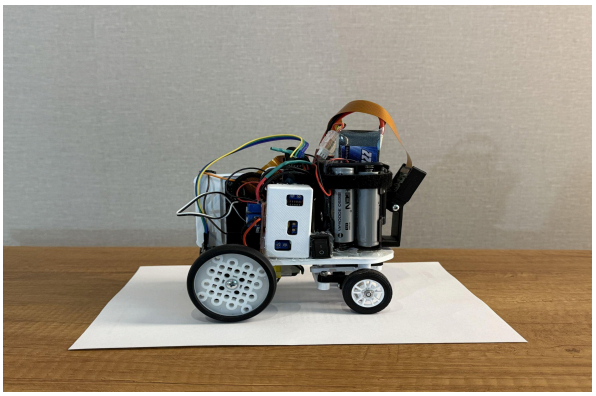
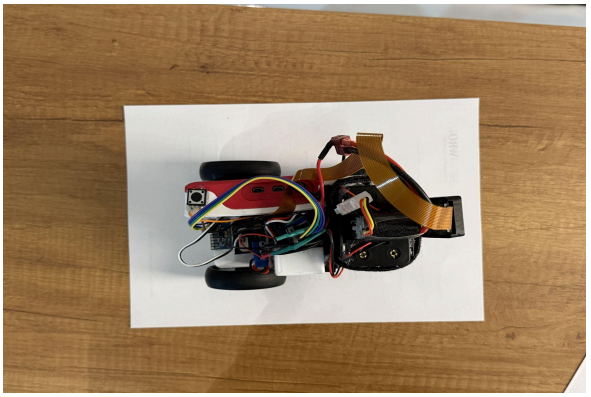
Bill Of Materials:

Object:	Number of pieces:	Price Per Piece:	Total price:
Pla+	500 gram	100 SAR Per Kilo	50 SAR
Small Front Wheels	2	3 SAR	6 SAR
Big Back Wheels	2	5 SAR	10 SAR
Dc motor: 6v, Tshape	1	10 SAR	10 SAR
Servo motor: mgDS 3240	1	20 SAR	20 SAR
Lithium Batteries	6	20 SAR	120 SAR
Raspberry pi 5	1	450 SAR	450 SAR
Step Down transformer: DC	1	10 SAR	10 SAR
Hbridge: L298N	1	20 SAR	20 SAR
Battery Case	2	3 SAR	6 SAR
Screw & Nut Kit:	1	30 SAR	30 SAR
Pi Camera V3 Wide angle	1	100 SAR	100 SAR
Servo Driver	1	25 SAR	25 SAR
Kit of Wires	1	10 SAR	10 SAR
Gyro: Gy-521	1	48 SAR	48 SAR
Total amount:			915 SAR

The Circuit Diagram :



Robot Photos:

3-Technical Documentation:

Activity Log:

Date	Description
Week 1	**Introduction to WRO, how the challenges work, rules and basis**
Week 2	**Arduino coding, Learning electronics skills**
Week 3	**Working on the robot, learning by application**
Week 4	**Built the first prototype, used it for the city qualifying stage**
Week 5	**Working on the robot used for the national qualifying stage**
Week 6	**Week of the competition**
Week 7	**Waiting for qualification decision**
Week 8	**Debugging and looking for improvements on the old design**
Week 9	**Working on the world finals robot**
Week 10	**Working on the world finals robot**

4-Testing and Performance Analysis (Obstacle management):

v1.0 Design Analysis:

Obstacle Challenge:

Lap time: 55s
Completing 3 laps journey: We were really struggling in completing the obstacle challenge since it was hard to minimize the error in color detection and we had about 30-40 failed attempts until we finally completed the 3 laps successfully.

Open Challenge:

Lap time: 31s
Completing 3 laps journey: Although the open challenge was easier than the obstacle, we had to focus on the speed and the accurate rotation of the robot to minimize collisions with the walls of the field and we used pixy lens cam and ultrasonic sensors for obstacle detection.

v2.0 Design Analysis:

Obstacle Challenge:

Lap time: 1 minute 07s
Completing 3 laps journey: This time our vehicle design was much better in success rate and speed of finishing the challenge due to the applied improvements, however we still faced some difficulty in color detection due to surfaces reflection and light color and intensity in the room and we had about 20-30 failed attempts.

Open Challenge:

Lap time: 58s
Completing 3 laps journey: to improve the open challenge performance we decreased the size of the robot for sharper turns, hence increasing accuracy and precision of the challenge. And replaced ultrasonic sensors and pixy with a webcam for more accurate detection.

v3.0 Design Analysis:

Obstacle Challenge:

Lap time: 1 minute 12s

Completing 3 laps Journey: The Pi Camera was the biggest help in the obstacle challenge and gave us a very clear image but we had a lot of trouble writing a working program and had a very poor success ratio with about 1 successful attempt every 5 attempts.

Open Challenge:

Lap time: 35s

Completing 3 laps journey: in order to have better time, we changed our program so that the robot takes the fastest route, and we used mgDS 3240 so that the robot can keep up with the sharp turns. This was our FASTEST Open Challenge success so far with only 1-10 failed attempts before we completed the challenge.

5- Robot performance videos:

v1.0 Open Challenge:

v2.0 Open Challenge:

v3.0 Open Challenge: