Final Design (Robocon 2026)

R1

Introduction

is the autonomous robot designed for Robocon 2026.

It must weigh between 40–50 kg, navigate multiple zones (Martial Club, Meihua Forest, and Arena), and also be capable of climbing stairs.

To achieve this:

- A tracked mobility system (rubber tracks) is selected instead of omni wheels.

- BLDC motors with planetary gearboxes will provide the required torque.

- High-current motor drivers (VESC) will control the motors.

- A LiFePO4 battery will supply stable and safe power.

⭕ 1. Motors + Gearbox

Type: 24V BLDC Motor – 500W each (Average weight 3.5~4 kg)x2

Gearbox: Planetary Gearbox, ratio 20:1 – 30:1. (Average weight 2~3 kg)x2

Target output torque: 30–45 N·m per motor.
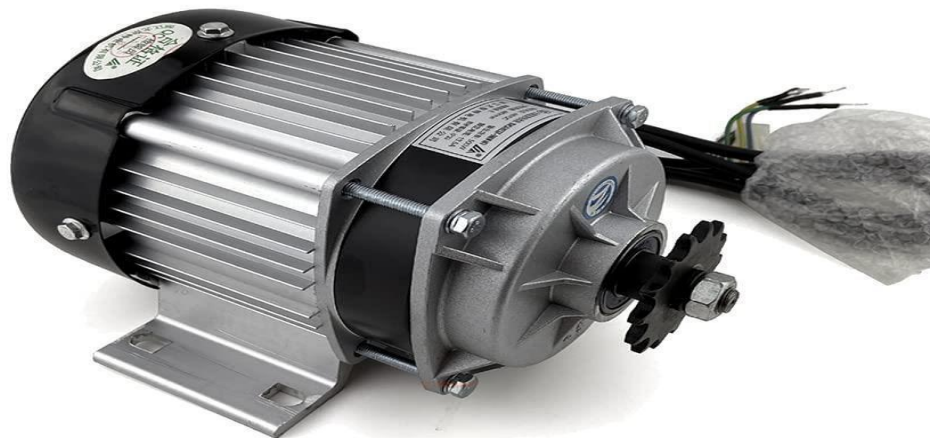
Expected speed: ~0.5 m/s while climbing stairs.

🔗 Amazon Links:

L-Faster 48V 500W BLDC Motor + Planetary Gear Reducer

Planetary Gear Clutch Kit (500–750W Motors)

| Specification	L-faster BM1418ZXF(BLDC)	
Rated Output Power	500W	
Rated Voltage	36V DC	48V DC
Rated speed	2800RPM	
No load speed	3100RPM	
Full load Current	≤17.8A	≤13.4A
No load Current	≤4.5A	≤4.0A
Rated Torque	1.7 N.m	
Efficiency	≥75%	
Gear ratio	1:6	
Application	Small and Medium size E-Tricycle	

◯ 2. Motor Drivers

1) VESC 75/300 → Recommended for BLDC motors, supports 24V, 60–80A peak, CAN/UART communication.

2) Alternatives (for brushed DC motors):

3) Sabertooth 2x25 or 2x50.

4) BTS7960 H-Bridge Module (budget option).

Total average weight: 0.5~.07kg
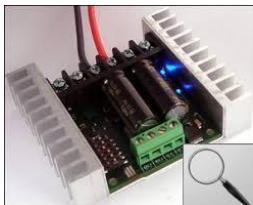
1) Recommended type: 24V LiFePO4, 30Ah.

2) Continuous discharge: ≥90A.

3) Peak discharge: ≥150A.

4) Built-in BMS (Battery Management System) required for protection.

5) (Average weight: 8~10kg)x2

◎ *Amazon Links:*

Forklift 24V 30Ah LiFePO4 Battery

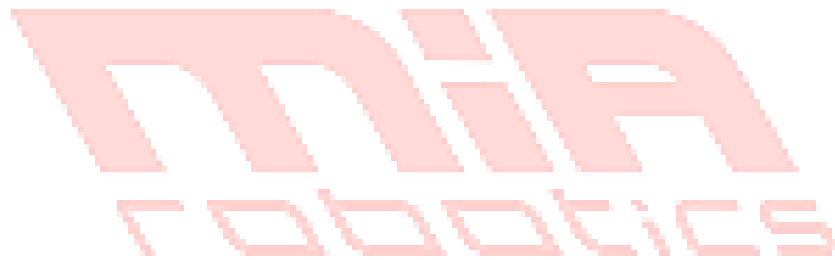WILLQR 24V Wheelchair Battery (20–40Ah)

FREEDOH 24V LiFePO4 Battery (30–50Ah)

o 4. Tracked Mobility System

1) Rubber tracks + sprockets provide the ability to climb stairs.

2) Stable traction and better weight distribution for a 40–50 kg robot.

3) Prevents slipping and ensures smooth movement on different surfaces.

4) Average weight 8~10kg

5. Electronics & Control

1) Controller (Raspberry Pi , Jetson , Arduino,…..etc).

2) Sensors (IMU, camera, Lidar,….. etc).

3) Estimated Wight:0.5~0.7

Robotic Arm Motor Selection

1) **High torque servo 12V**

2) extra high torque servo (60kg)

3) high torque servo (15kg)

4) 16-channel pwm driver to control multiple servos

Overall weight of arm :2.5~3.5kg

component	QTY	Approx weight	Approx size
Motors + Gearbox	2	12~14	12x12x25
Motor Drivers	2	0.5~.07	5x8x12
Battery	2	8~10	15x12x25
. Tracked Mobility System	1	8~6	15x40x60
Electronics & Control		0.5~0.7	15x15x40
ROBOT ARM	1	1~2	15x15x40
total		43~48kg	~90x70x80

The overall system fits within the required maximum size constraint of 1m × 1m × 1m, with an estimated total weight of 43~48kg

Total power consumption

1. Base BLDC motors 500w x2=1000w

2. Arm servos 15W+18W+44Wx3 ~165W

3. Electronics & sensors~20-30W

Total peak power

~1.2-1.3kw

Battery

i. 24v,30Ah~720Wh x2 =1440Wh

The batteries sufficient for short tasks(reach 1hour)

Conclusion

1. BLDC+gearbox=high torque efficient for climbing

2. Lifepo4 battery =safe stable ,long cycle life

3. Ruber tracks =good traction ,stability

4. High torque servos-> strong grip,reliablty

Final Design (Robocon 2026)

R2

Introduction

is the autonomous robot designed for Robocon 2026.

It must weigh between 40–50 kg, navigate multiple zones (Martial Club, Meihua Forest, and Arena), and also be capable of climbing stairs.

Reasons for using a six-wheeled stair-climbing design:

Provides better weight distribution and stability, even if one wheel is between steps.

Ensures higher climbing capability with more contact points and friction.

Allows efficient torque distribution using smaller motors with gearboxes.

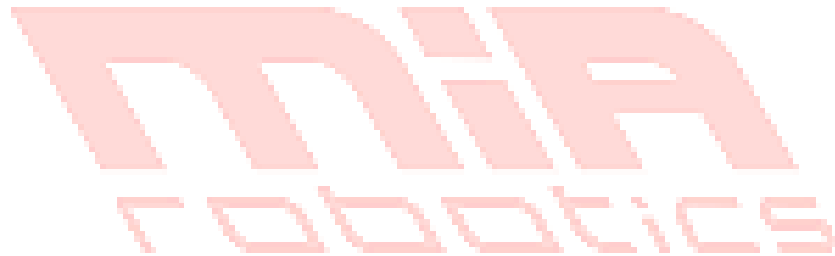Offers strong adaptability to obstacles such as stairs, holes, and uneven terrain.

○ 2. Electronics & Control

1) Controller (Raspberry Pi , Jetson , Arduino,…..etc).

2) Sensors (IMU, camera, Lidar,….. etc).

3) Estimated Wight:0.5~0.7

○ *3. Battery*

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1)   LifePO4 Phosphate Lithium Battery 3.2V 40Ah (we'll put 7 of those in series , it has low weight, and sufficient ampere) (from makers)

(Average weight: 8.5kg)

◎ *Amazon Links:*

Forklift 24V 30Ah LiFePO4 Battery

WILLQR 24V Wheelchair Battery (20–40Ah)

FREEDOH 24V LiFePO4 Battery (30–50Ah)

○ 4. WHEEL's MOTOR

Assumptions:

Mass=50kg (assumed we reached the threshold for safety)

Wheel radius= 0.1m

Acceleration=0.8 m/s^2

Max_speed=2m/s

Crr=0.02 (the standard)

Calculations:

The total force needed to overcome is= 50*0.08+50*9.81*0.02=49.81N
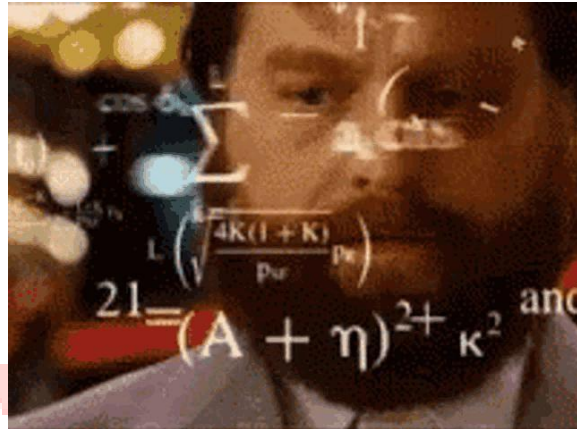
FORCE/Motor=12.45

Torque_motor=F*r=1.245 N.m

The normal safety factor for this project would be 1.5-2 but since this robot will climb elevated surfaces I assumed safety factor to be 2.3

So torque will be=2.864 N.m

W=Vmax/r=20rad/s

RPM=190.99

So the power rating of this motor would be 80 watt

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1. JGB37-545 High Torque Gear Motor 24VDC 200RPM 24Kg.cm(risk of too low torque, makers so local)

2. JGB37-545 High Torque Gear Motor 24VDC 66RPM 35Kg.cm (no risk but slow, makers so local)

3. 24V 150W High Torque Dc Gear Motor 120 rpm With 42 mm Planetary Gear Box Encoder Motor for 100kg Big Load Smart Mecanum Wheel Robot Car (perfect but from aliexpress so high shipping costs)

4. Links:

5. https://makerselectronics.com/product/jgb37-545-high-torque-gear-motor-24vdc-200rpm-24kg-cm-with-bracket/

6. https://makerselectronics.com/product/jgb37-545-high-torque-gear-motor-24vdc-66rpm-35kg-cm-with-bracket/

7. https://ar.aliexpress.com/item/4001278858460.html?gatewayAdapt=glo2ara

Suitable motor drivers:

- Cytron MD30C DC Motor Driver 30Amp 5V-30V (very suitable but we'll need 4 of those)
- Cytron MDDS60 Smart Drive DC Motor Driver Dual Channels 60Amp 7V-45V (perfect and we will only need 2 or 1 with safety risks)
- Cytron MDDS10 Smart Drive DC Motor Driver Dual Channels 10Amp 7V-35V (most economic in space and price and we will need only 2)

LINKS:

https://makerselectronics.com/product/cytron-mdds10-smart-drive-dc-motor-d/?campaignid=20503411856&adgroid=up&network=x&device=c&campaignname=sales_pmax&gad_source=1&gad_campaignid=20503433012&gbraid=0AAAAApRJSNEnpruY7GDOTMEB21eS6thB5&gclid=CjwKCAjwiY_GBhBEEiwAFaghvlAcw30qmV76nahhF4ZkvJEb18el2DIglirtS1m1PjlXlgE9NHXvWhoCWdUQAvD_BwE

https://makerselectronics.com/product/cytron-mdds60-smart-drive-dc-motor-d/?campaignid=20503411856&adgroid=up&network=x&device=c&campaignname=sales_pmax&gad_source=1&gad_campaignid=20503433012&gbraid=0AAAAApRJSNEnpruY7GDOTMEB21eS6thB5&gclid=CjwKCAjwiY_GBhBEEiwAFaghvt-lqap95d_kejSUQtuJgLd8i6oIoBOkcgS69mYsuTUngzE5pYKDCxoCTUUQAvD_BwE

https://makerselectronics.com/product/cytron-md30c-dc-motor-driver-30amp-5/?campaignid=20503411856&adgroid=up&network=x&device=c&campaignname=sales_pmax&gad_source=1&gad_campaignid=20503433012&gbraid=0AAAAApRJSNEnpruY7GDOTMEB21eS6thB5&gclid=CjwKCAjwiY_GBhBEEiwAFaghvjVehJirEB6aAptcZcusLHyirSQPSGilAoeafDX_ZFGvdCpnj9zy2hoCbLcQAvD_BwE

6.ROBOT ARM

Robotic Arm Motor Selection

1) **MG996R Servo Motor Tower Pro 180 Degree (Full Metal Aluminum Gear)** ~15w

2) MG99-HIGH-Tourq12kg/cm- Pro 180 Degree ~18w

3) Powerful Aluminum 180 Degree Digital Servo Motor for 1/8 1/10 RC Cars Traxxas X4 Baja RC4WD GTR and More VITEK (180 Degree -35kg) ~44w

4) 16-channel pwm driver to control multiple servos

Overall weight of arm :2.5~3.5kg

component	QTY	Approx weight	Approx size
Motors + Gearbox	3	2~3.5	12x12x25
Motor Drivers	4	0.5~.07	5x8x12
Battery	1	8~8.5	15x12x25
wheel & design	1	8~6	15x40x60
Electronics & Control		0.5~0.7	15x15x40
ROBOT ARM	1	1~2	15x15x40
total		35~40kg	~80x75x55

The overall system fits within the required maximum size constraint of 1m × 1m × 1m, with an estimated total weight of

35~40kg

Power Calculation (Watts)

Wheel motors

JGB37-545 motor ~ 80–150 W

Quantity: 3–4

Total power: 240–600 W

Arm servos

MG996R = 15 W

MG99-HIGH-Torque = 18 W

VITEK servo = 44 W

Total: 15 + 18 + 44 = 77 W

Electronics & sensors

Raspberry Pi / Jetson / sensors ≈ 20–30 W

Total peak power:

240–600 + 100 + 30 ≈ 370–730 W

Battery

- Type: LiFePO4 (Lithium Iron Phosphate)

- Cell voltage: 3.2 V

- Capacity: 40 Ah

- Energy per cell: 3.2 V × 40 Ah = 128 Wh

- Number of cells in series for 24 V: 7

- Total nominal voltage: 7 × 3.2 V ≈ 22.4 V

- Total energy: 7 × 128 Wh ≈ 896 Wh

- Estimated runtime: ~1 hour at average load (~500 W)

Conclusion

1. BLDC+gearbox=high torque efficient for climbing

2. Lifepo4 battery =safe stable ,long cycle life

3. Ruber tracks =good traction ,stability

4. High torque servos-> strong grip,reliablty