

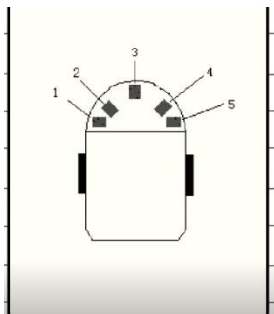
Sensor

Ok first of all, we will talk about sensors we had 3 options:

- 1) IR sensor : It's a really famous sensor used in competition, cheap and works with infrared but it's a little slow
- 2) ToF: it uses light as a signal which makes it vulnerable to any bright environment, but it's very fast
- 3) Ultra sonic: It's cheap uses sound, but it's slow and has a big size

So after comparing each sensor we decided to use the IR as we don't guarantee a free bright environment

About the placement we will use 5 IRs in this shape:



With this rules:

Heights & angles

Sensor center height \approx mid-wall height in your maze (commonly 20–30 mm from floor).
Side IR inward tilt $5\text{--}10^\circ$; front-angled $\pm 15\text{--}25^\circ$ from the forward axis.

Shielding

Add side baffles and matte-black paint around sensors to block cross-talk and floor reflections.

Rigid mounting

Use slots for ± 2 mm adjustment during calibration.

Keep nose short

Short front overhang improves turning clearance and keeps front sensor close to the wall for accurate stopping.

Making sure that we don't put any reflective material such as aluminum so it doesn't miss with the IR

With the proved layout:

Minimal competitive layout (5 sensors + encoders + IMU)

Side IR (2): left & right, mounted ~5–10° inward.

Front IR (1): straight ahead for front wall distance/stop.

Front-angled IR (2): ±20° to see corners early.

Encoders (2): integrated on motor shafts or wheel hubs.

IMU (1): near the center of mass, horizontal, away from motors.

Advanced layout (ToF hybrid)

Replace the **front IR** with **1× ToF (VL53L1X)** for a linear, mm-level front distance.

Keep **side IR pair** for fast lateral control (higher update rate than most ToF setups).


Keep **front-angled IR pair** for corner anticipation.

the motor:

We'll use N-20 as it's a light with understandable speed and torque

Motors

Motors will affect your micro mouse in almost all the aspects and good motors will make you win! In general micro mouse designs, the width of the micro mouse is decided by the length of the motors. Since the practice is to make the mouse small as possible, designers tend to use small motors and they end up picking micro-metal gear motors. Interesting fact is, there are so many different micro-metal gear motors with different RPM values.



The most common micro-metal gear motor in the market is the well known N-20 motor. Also, developers have specifically made encoders for these motors. Also, since the sizes of the motors of different RPM's are almost same, switching between motors is easy.


And it's also equipped with encoder to control it.

So what we need to do is to figure out which gear ratio we're gonna use in the gearbox assuring good RPM and speed.

There's the upgraded N-20:

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JGB37⁵⁵⁵
GEARED MOTOR

6mm Ø

The most common micro-metal gear motor in the market is the well known JGB37 motor. Also, developers have specifically made encoders for these motors. Also, since the sizes of the motors of different RPM's are almost same, switching between motors is easy.

But considering that we'll make a small robot we preferred N-20.

For the motor calculations:

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Specs: 12 V, 217 RPM (rated), 0.37 N·m (rated), 1.2 A (rated), 6.5 A (stall), ~300 g

Wheels (pick one):
Ø42 mm → ~0.48 m/s (stable exploration)
Ø50 mm → ~0.57 m/s (a bit faster)

Braking @ $a_b = 4 \text{ m/s}^2$:
Ø42: $d_{\text{stop}} = 2.9 \text{ cm}$ | Ø50: $d_{\text{stop}} = 4.1 \text{ cm}$

Traction cap: $\mu \approx 0.6 \Rightarrow a_{\text{max}} \approx 5.9 \text{ m/s}^2$ (torque is ample; friction is the limit)

Encoder math (if 6 PPR motor \Rightarrow 24 edges; 18.75:1):
450 counts / wheel-rev \rightarrow Ø42: 0.293 mm/count (\approx 614 counts/18 cm)
Ø50: 0.349 mm/count (\approx 516 counts/18 cm)

Driver: 12 V H-bridge with $\geq 6.5 \text{ A}$ peak per motor (e.g., VNH5019, BTS7960, Cytron MD13S x2)

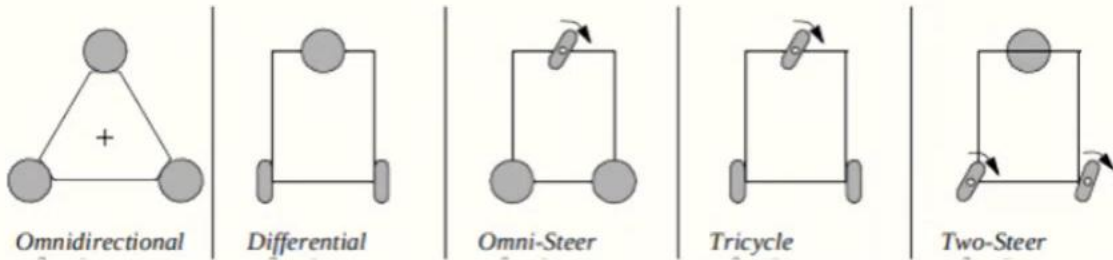
Battery (competition 12 V): 3S LiPo (11.1 V nominal, 12.6 V full), 1000–1500 mAh, $\geq 30\text{C}$
Typical draw: ~2.4 A (2 motors at rated) + 0.2–0.4 A electronics \Rightarrow ~20–40 min runtime
Add 10 A fuse, bulk caps at driver, LVC $\approx 3.5 \text{ V/cell}$ under load

Sensors: 4× IR (2 side 5–10° in, 2 front-angled $\pm 20^\circ$) + 1× ToF front (enforce d_{stop} + latency)

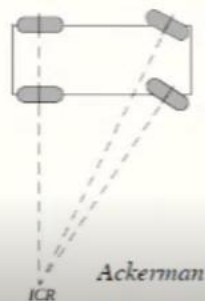
the wheels:



3-wheel platforms



4-wheel platform



Our robot is small that's why we will use the differrnitial configuration with an omni wheel for stability.

As for the wheel calculations:

Robots with large wheels are often more eye-catching than robots with small wheels, but don't let looks affect your design! The right wheel size is very important and care should be taken to choose the right one for each specific robot. Two main equations need to be considered:

$$(\text{forward}) \text{ velocity} = \text{angular velocity (of the wheel)} \times \text{radius (of the wheel)}$$

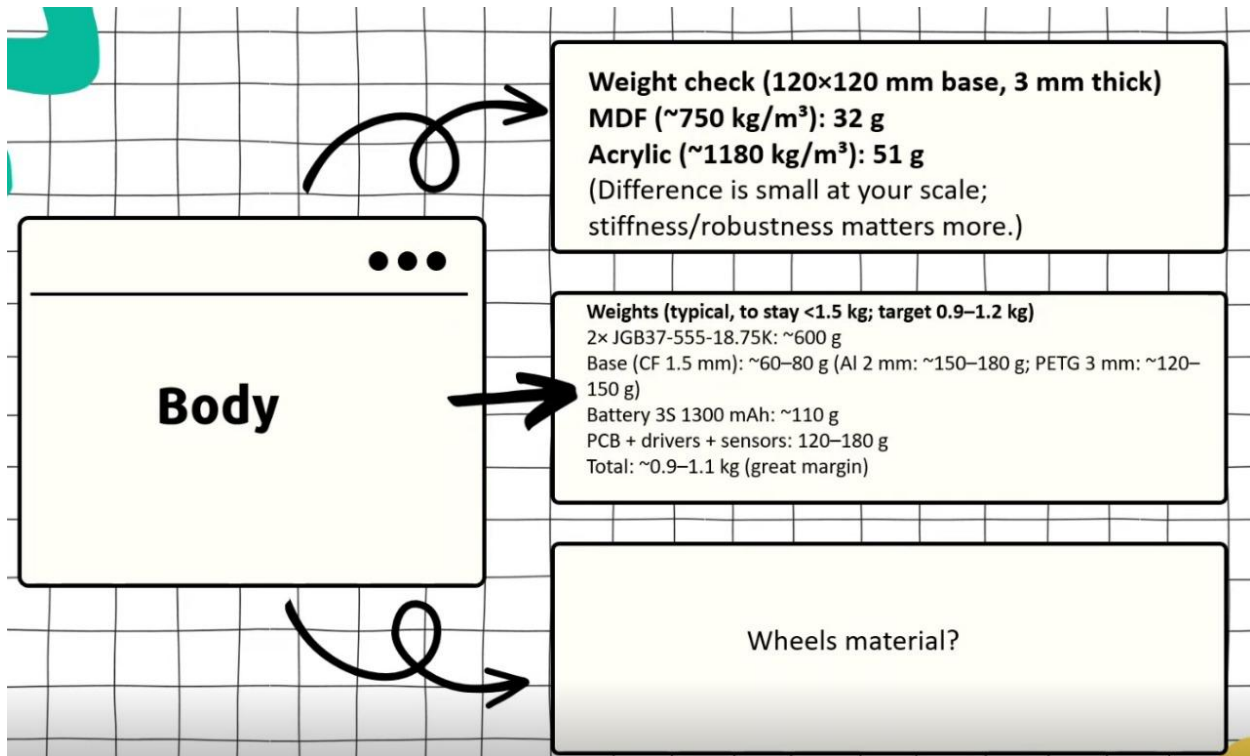
This means that both the radius of the wheel and the angular speed at which it's turning will affect the forward velocity.

$$\text{force (exerted by the wheel on the surface)} = \text{torque (of the motor)} / \text{radius (of the wheel)}$$

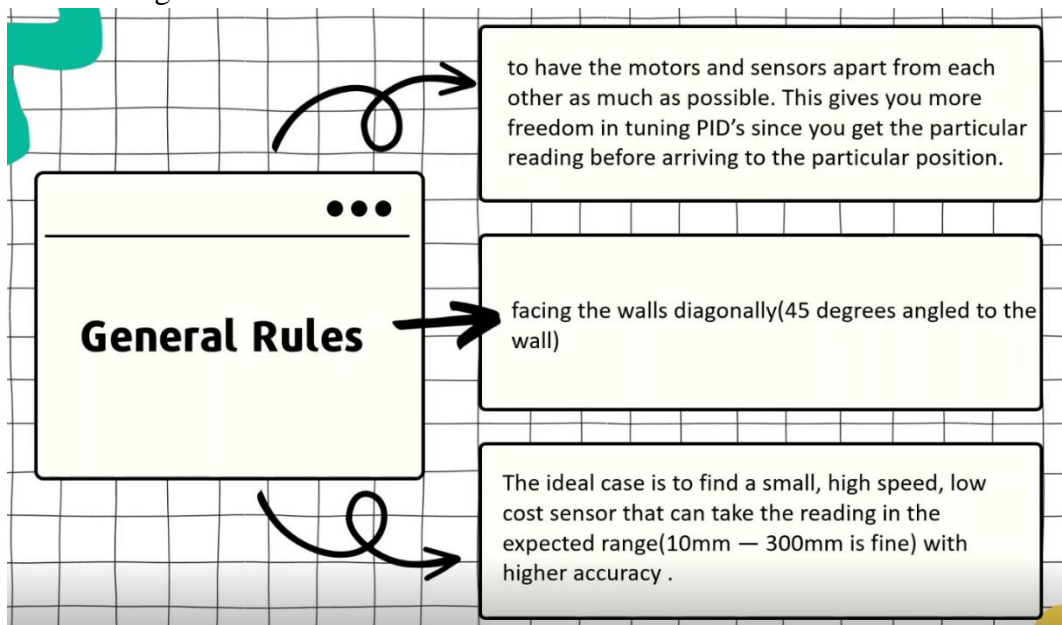
As for the wheel material we can't have a smooth wheel because it has a little friction which will be unstable rather it's preferred to use a rubber like wheel material.

Body:

As for the body it's recommended to use acrylic as carbon fiber is not available in Egypt



With those general rules



And an important rule is that :

Height < Width

Battery:



We'll use 3S 1300 mAh as it's light and can provide the power needed for the robot.

The battery will be placed in the center of the robot

Prototype

