Sensor

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

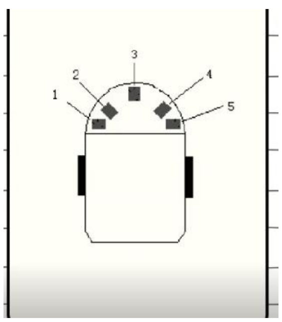
1) IR sensor : It’s a really famous sensor used in competition, cheep and works with infared but it’s a little slow

2) ToF: it uses lighr as a signal which make it vonurable to any bright environment, but it’svery fast

3) Ultra sonic: It’s cheep 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 garnetee a free bright environment

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



With this rules:

Heights & angles
Sensor center height ≈ mid-wall height in your maze (commonly 20–30 mm from floor).
Side IR inward tilt **5–10°**; front-angled **±15–25°** 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 refelective material such as aluminum so it don’t miss with the IR

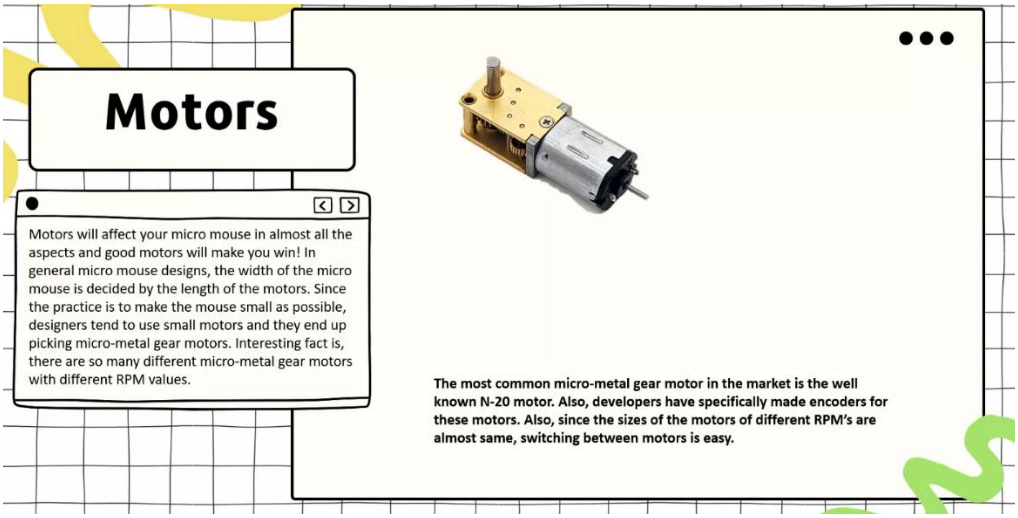
With the proved layout:

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:

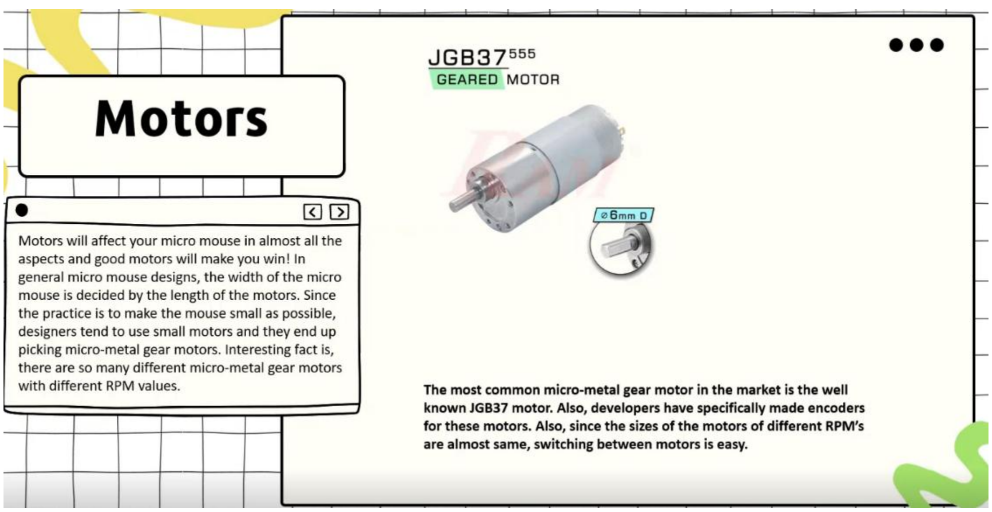
We'll use N-20 as it's a light with understandable speed and torque



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

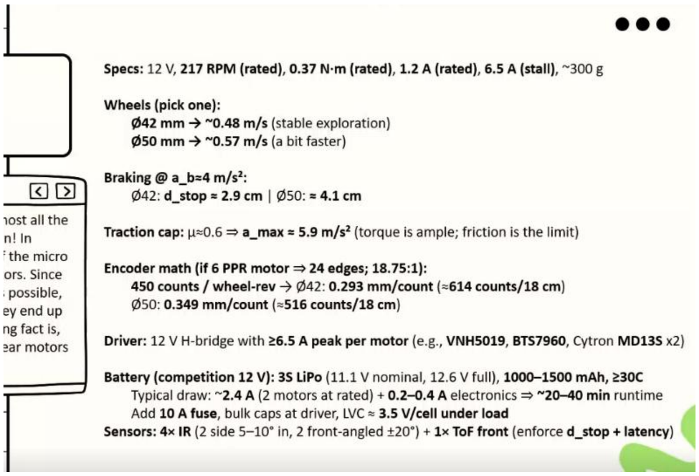
So what we need to do is to figure out which gear ratio we're gonna use in the gearbox assuring good RPM and speed.

There's the upgraded N-20:

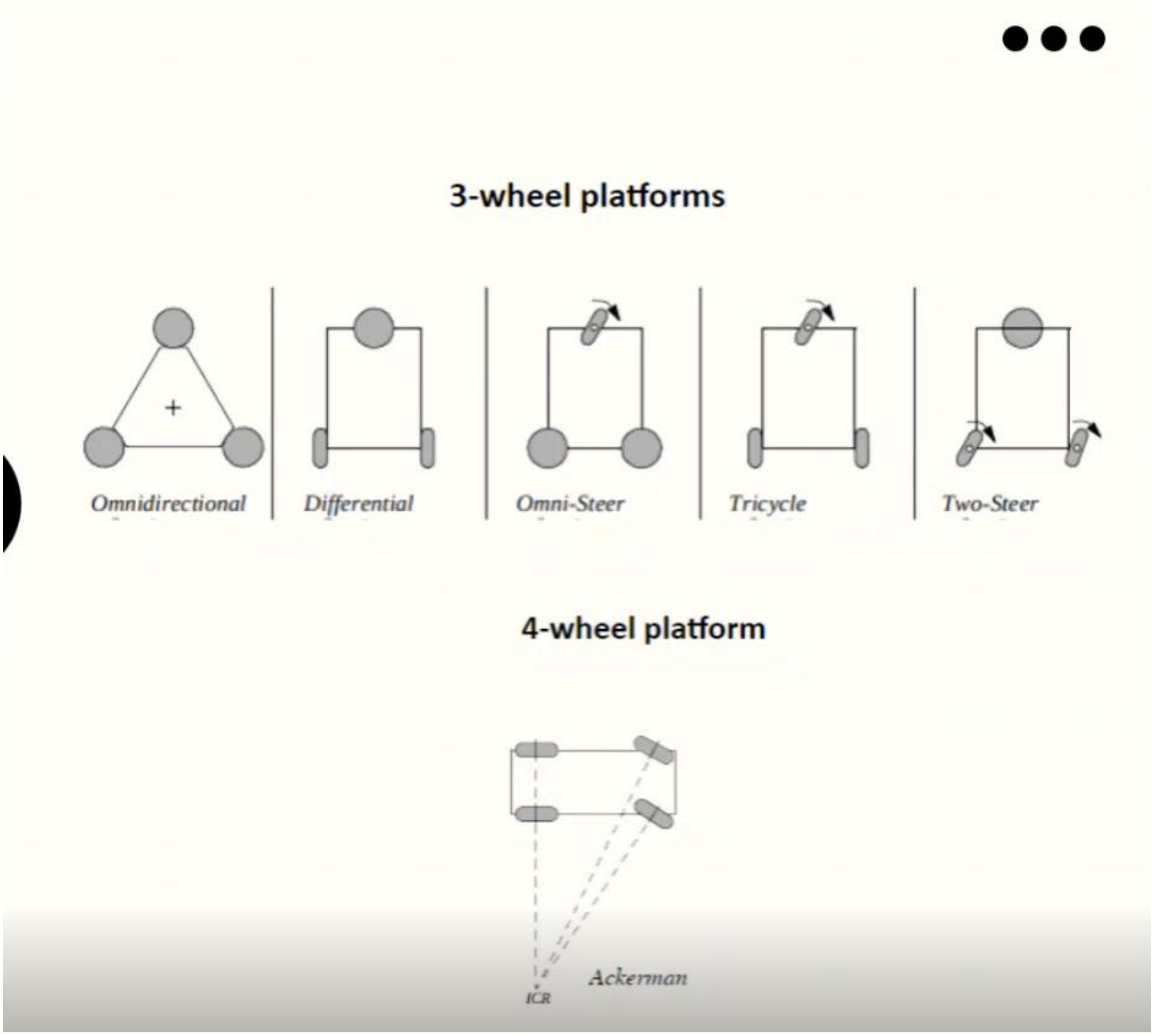


But considering that we'll make a small robot we prefred N-20.

For the motor calculations:



the wheels:



Our robot is small that's why we will use the differnitial 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:

(forward) velocity = angular velocity (of the wheel) x radius (of the wheel)

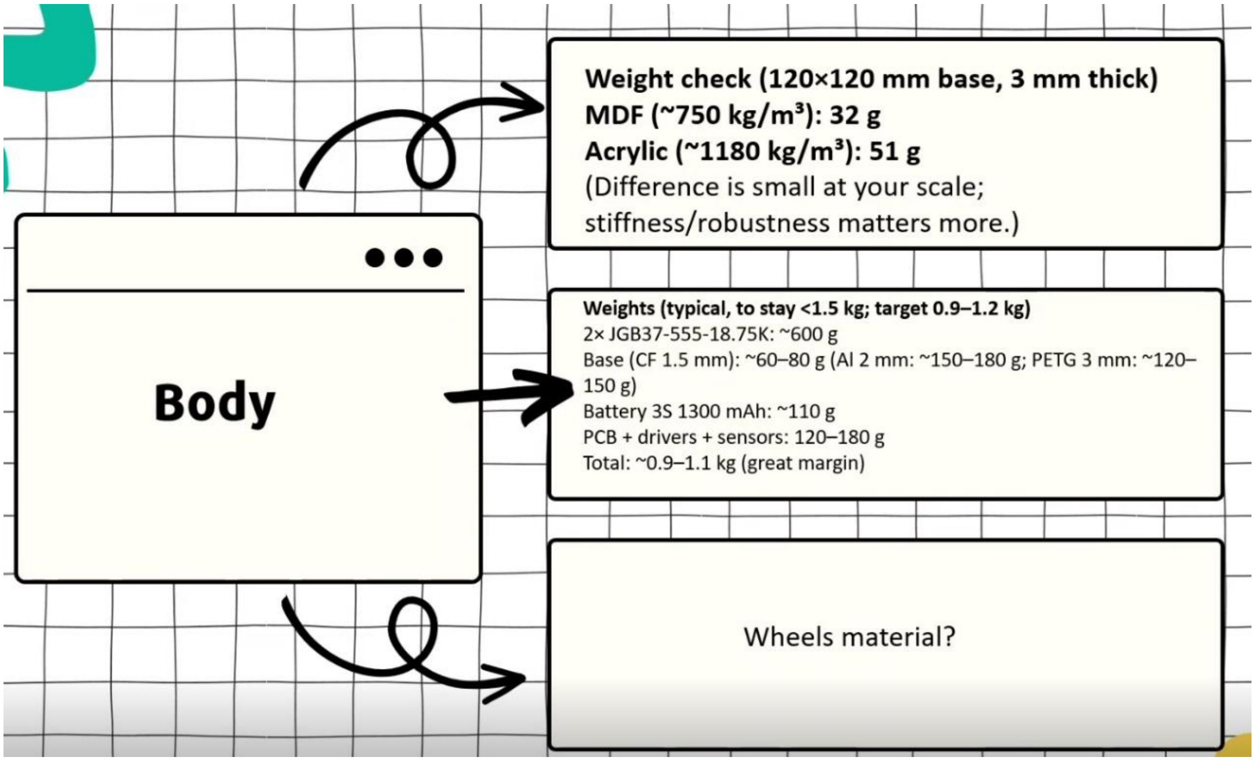
This means that both the radius of the wheel and the angular speed at which it's turning will affect the forward velocity.

force (exerted by the wheel on the surface) = torque (of the motor) / radius (of the wheel)

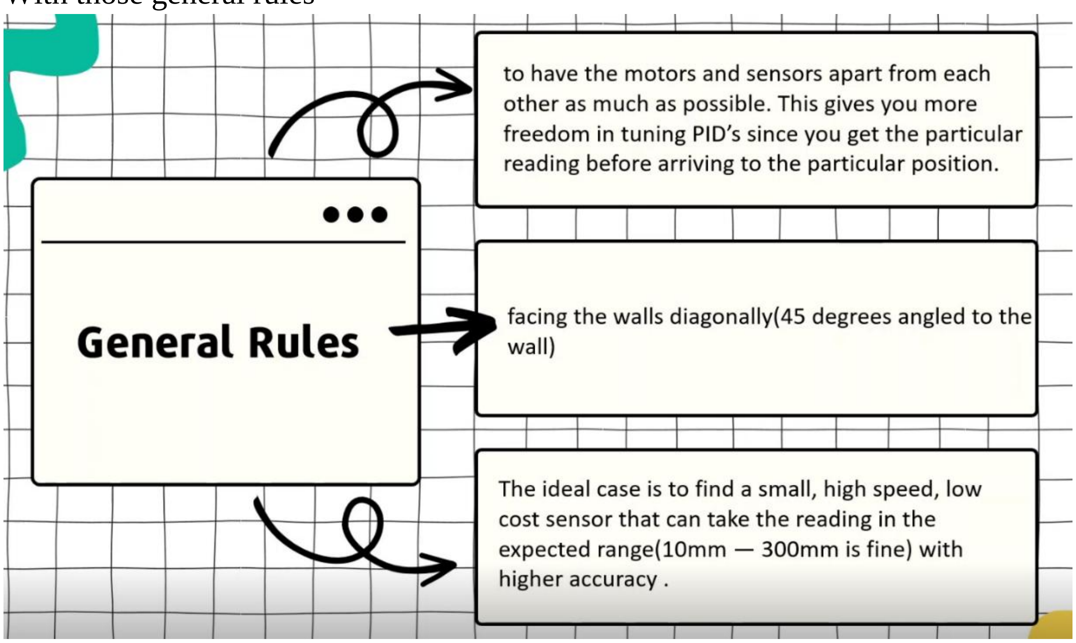
As for the wheel material we can’t have a smooth wheel because it has a little friction which will be unstable rather it’s preferred to use a rubber like wheel material.

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