XLR8
Mechanical session

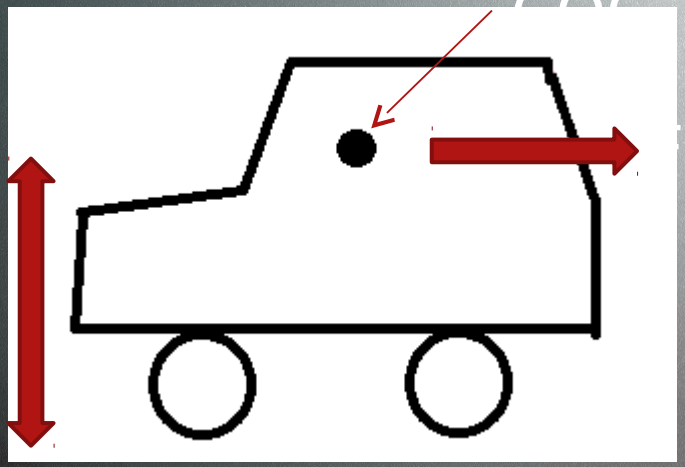
STAB | students' technical activities body

IITB Robotics Club

Center of Gravity

- A lot of care must be taken about center of gravity.
- The robot must be very stable and should be prevented from toppling , and other stability problems.
- COG Height should be low, to avoid toppling while:

1. Negotiating inclines or jumping.
2. Facing Impulsive force at start of motion.



(Pseudo force)

$T = F*D$

WHEELS

- General size of wheels available in the market vary in size between 5-10cm in diameter.
- Small wheel- lower top speed, higher acceleration.
- Large wheel- higher top speed, lesser acceleration, difficulty in climbing incline.
- Suggested to use wheels of 6cm diameter.

- One should use wheels of same diameter both on the front and back if using same RPM motor to prevent unwanted friction produced due to different velocities of wheels. (power loss)

Four wheel drive

- More number of motors = more torque.
- Easy to climb inclined plane.
- If not aligned properly in one plane one motor useless as it looses contact with ground.
- Different RPM(with same diameter of wheel)

1. Front and rear different(Power loss as friction averages the speed)
2. Two sides different (Bot doesn’t move in straight line)

- Suggested to use as it can easily climb inclines and easiest to make and control.

Three wheel drive

- Minimum no of points to form a plane so very stable on any surface.(plane or terrain)
- Wheels always in contact with the ground.
- Only 2 motors

1. Less power consumption (Battery last long)
2. Less torque (Difficult to climb incline)

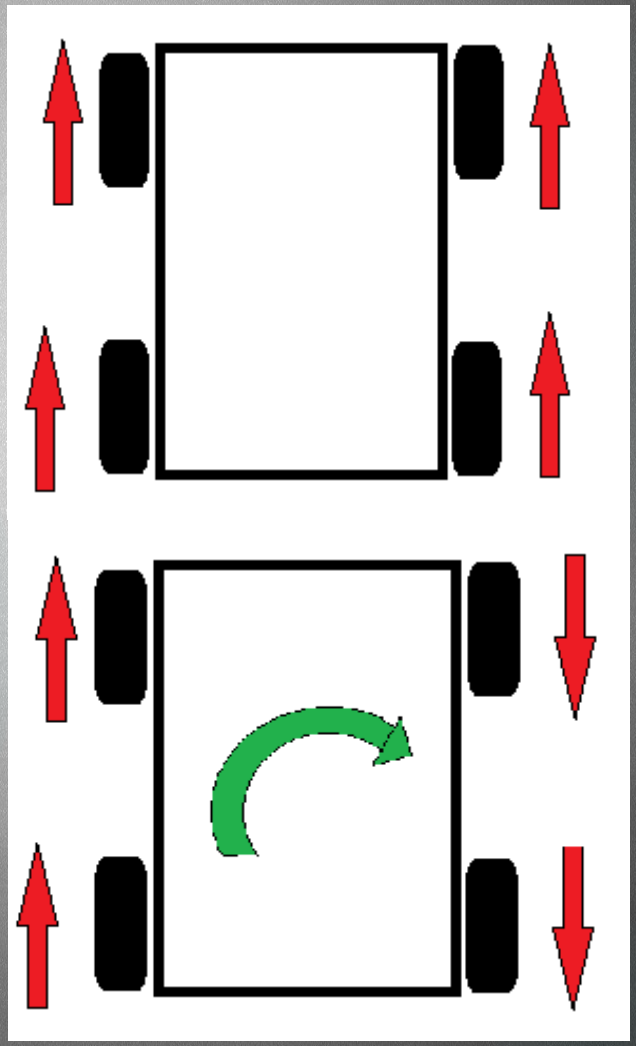
- Bit difficult to make.

STEERING MECHANISM

- Differential mechanism.
- Axle mechanism.
- Rack and pinion.

Differential

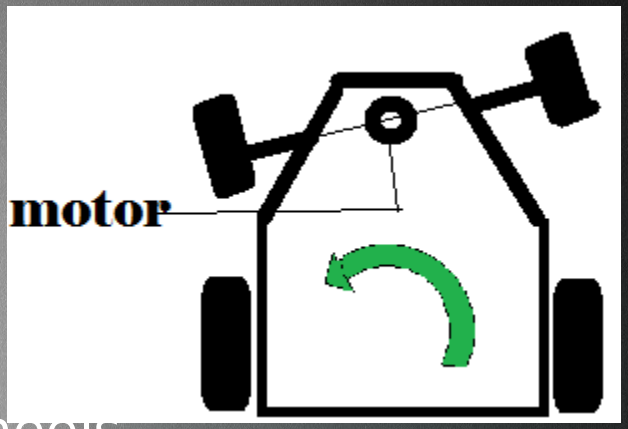
- Car takes turn due to the relative motion between wheels.
- Bot moves front.
- Bot turns right.



Advantages of differential

- Easy to make.
- Easy to control.
- No need to attach any new motors for steering.
- Can take sharp and quick turns.

Axle mechanism



- A motor placed vertically

  turns the axle.
- Bot can turn to any radius.
- Motors are attached only to the rear wheels.
- The motor used for turning must have very less rpm around 10-30 rpm.
- usually not quick.
- Accurate steering is not possible as motors don’t stop instantaneously when switched off.(Difficult to make small turns)

Rack and pinion

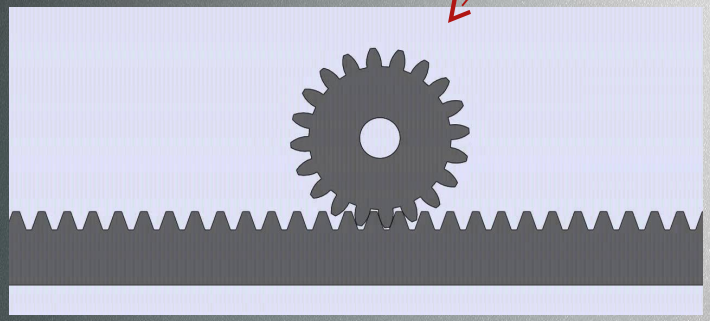
- Stud mechanical design.
- Similar thing used in actual cars!
- Only 2 motors for power

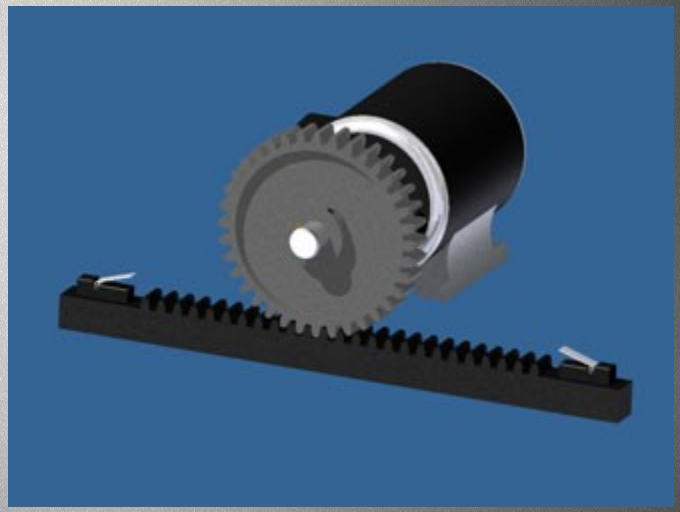
1. Less power consumption (Battery last longer)
2. Less torque (Difficult to climb incline)

- One motor for steering.
- Very challenging!

What is Rack & Pinion

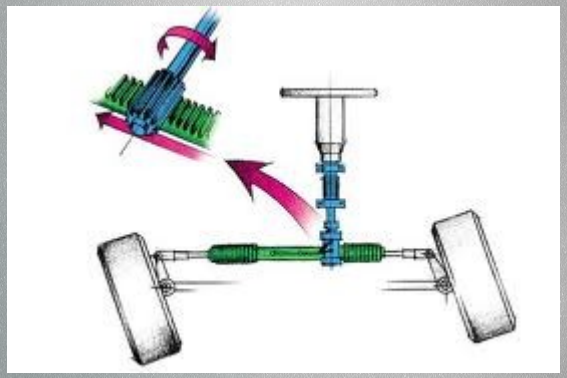
Pinion





Rack

Rack & Pinion as steering mech.



MOTORS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MOTORS

- Choosing the motors is a very big task as a wide variety of motors of different **r.p.m , torque, size, power, weight, material** are available in the market .
- There is always a tradeoff while selecting the motors as torque and r.p.m are **inversely** proportional for given power.

$$P = \tau * \omega$$

- It is suggested to use motors of rpm between 150-300.
- Higher rpm motors are difficult to control.
- Cost is always a contributing factor.

Types of motors

- Plastic BO motors are used if the bot needs to be light weight but they have a weak shaft and lesser torque.
- Metal motors are heavy but strong and reliable gears. (Most preferred)
- Servo motors: (Not needed in XLR8)

1. Can rotate to specified angles.
2. Can rotate only between 0-180 degree.
3. Highly accurate.
4. Needs microcontroller to control.

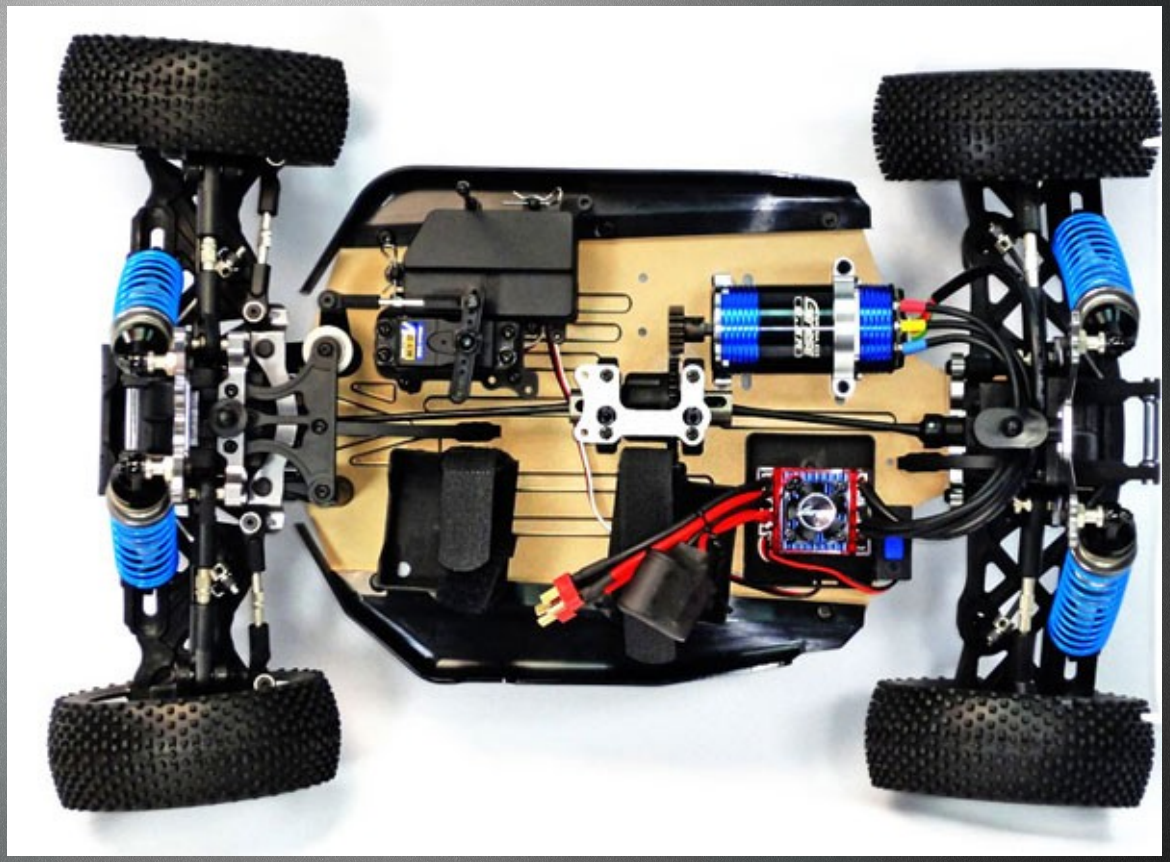
Metal
DC motor

BO motor

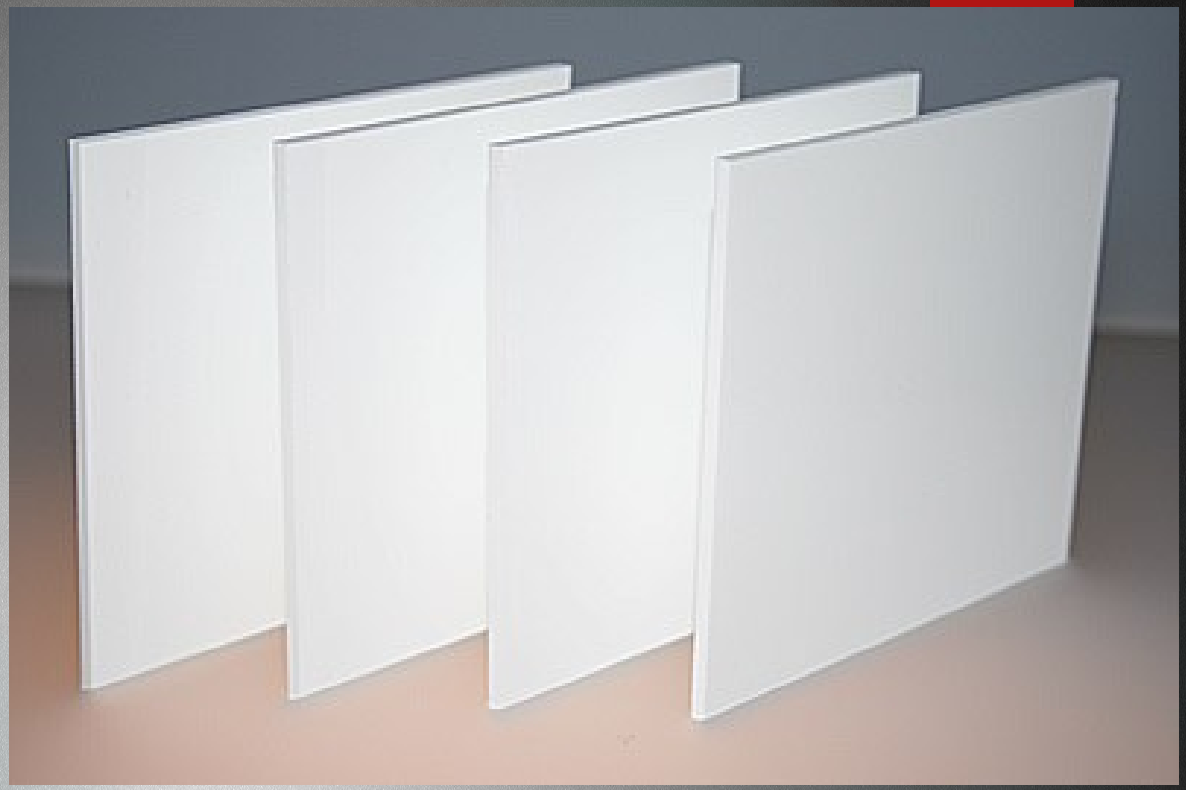
Servo motor

Material for chassis

- Acrylic
- Aluminum
- Wood



Acrylic



- Advantages

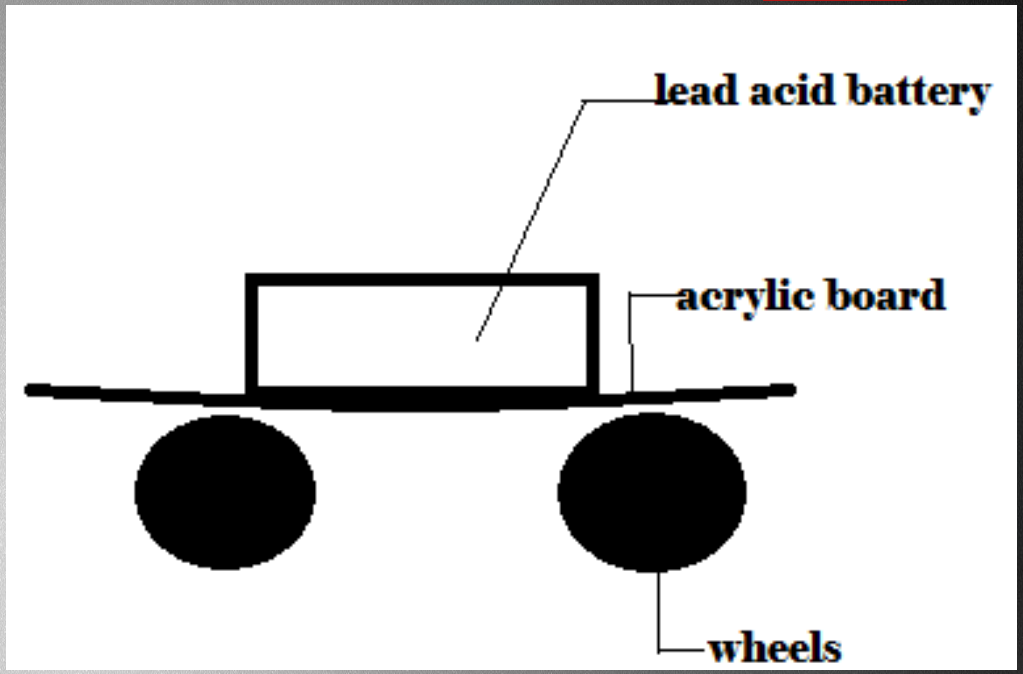
- Light weight.

- Easy to work with. (cut & drill)

- Transparent sheets are available which can be used in robots where internal mechanism are to be displayed.

Disadvantages

- On application of load it bends.
- Brittle & fragile.
- Not able to sustain shocks and powerful jerks during impact or jumps.
- Not reliable for long term usage of machine.



Aluminum

- Advantage
  - Light weight
  - Easy milling (compared to other metals)
  - Readymade sections, bars, boxes etc are easily available in the market which can be directly used
  - More strength to weight ratio
- Disadvantage
  - Sheet of same dimension is very heavy as compared to rest of the two materials

Wood

- Advantages
  - Lightest among the three
  - Relatively cheaper than ac
  - Easy to work with.
- Disadvantages
  - Weaker than aluminum.
  - Not Waterproof.

Battery

- We generally use 4 types of batteries.

1. Lead-acid battery – Rechargeable, generally used
2. Lithium Ion (Li-ion) battery.
3. Lithium Polymer (li-po)
4. Nickel Metal Hydride (Ni-MH) battery.

Which battery to use?

- Lead acid batteries- Heavy , cheap, easy and safe to use.
- Lithium ion battery-light weight , costly , careful charging needed.
- Lithium polymer- light weight , very costly , careful charging and balancing needed.
- Nickel metal hydride-slightly heavy , safe to use.

Thank You

Doubts?