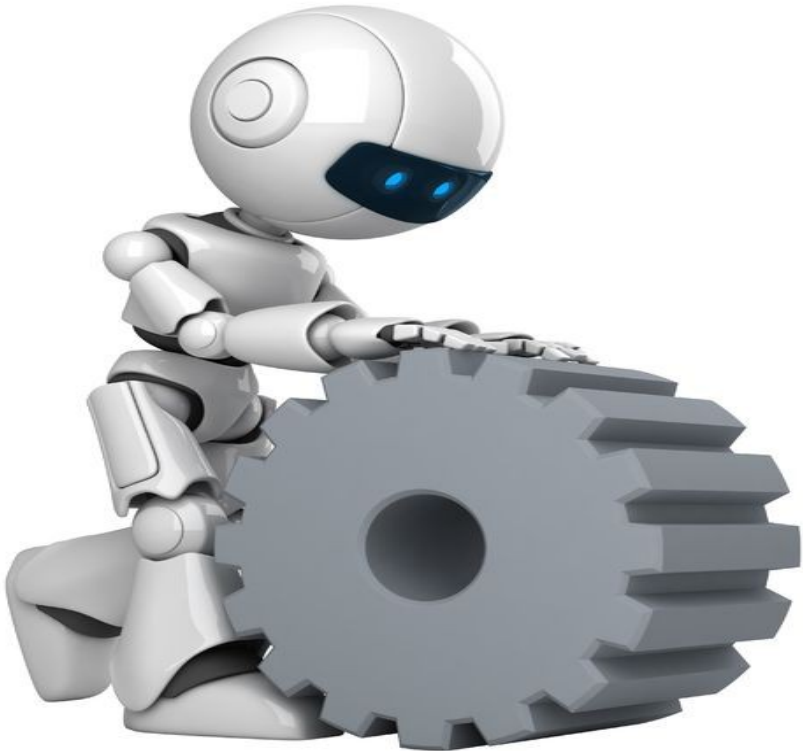
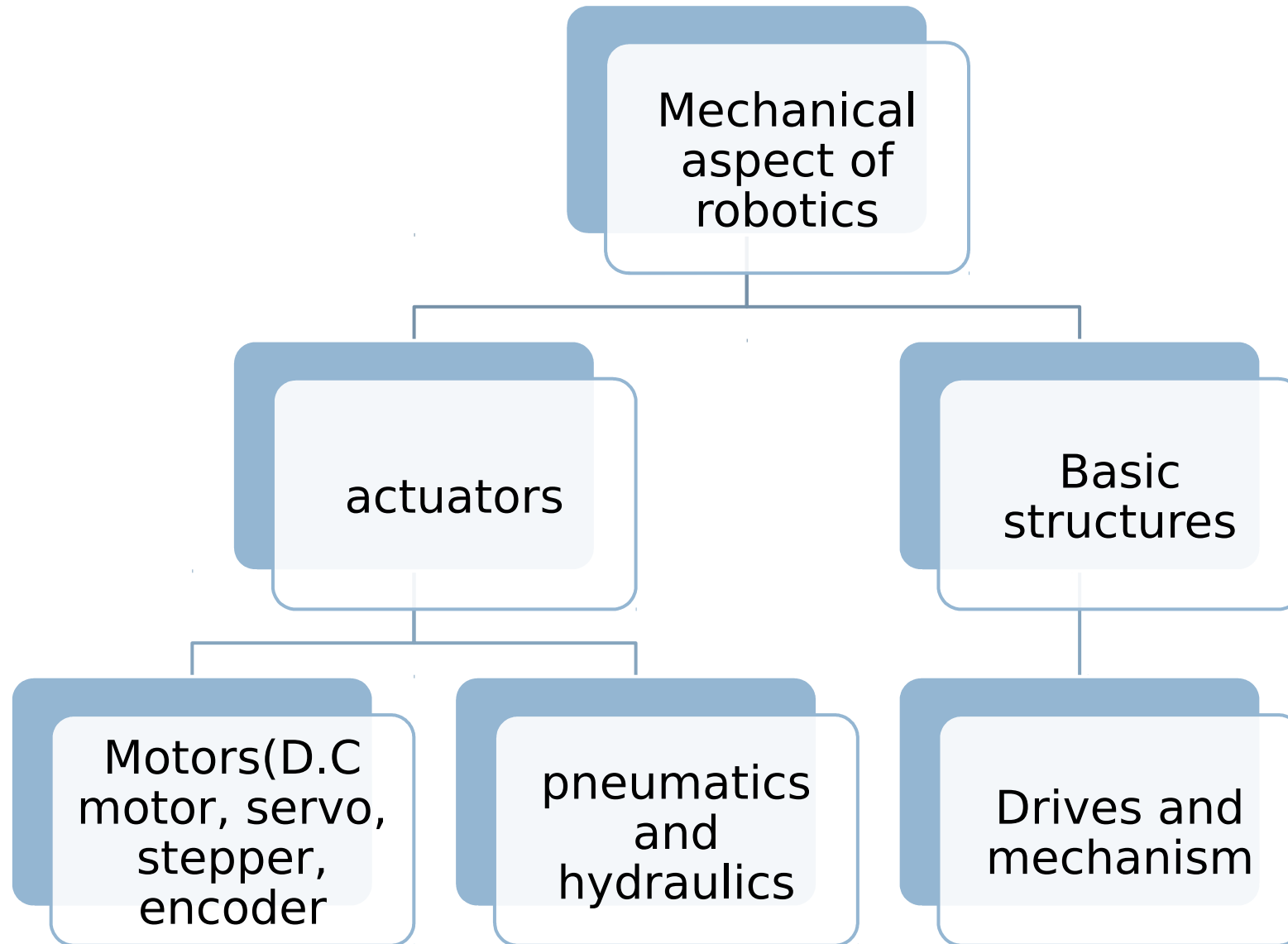


MECHANICAL ASPECT OF ROBOTICS



By
NITISH GARG
SHASHANK MAURYA



What is an actuator?

- An actuator is something that converts energy into motion.
- Actuator take fluid, electric or some other source of power and convert it through a motor, piston or other device to perform work
- Actuator may rotate an object ,open or close a device or push a surface up or down , but they always put something into motion

Hydraulic Actuators

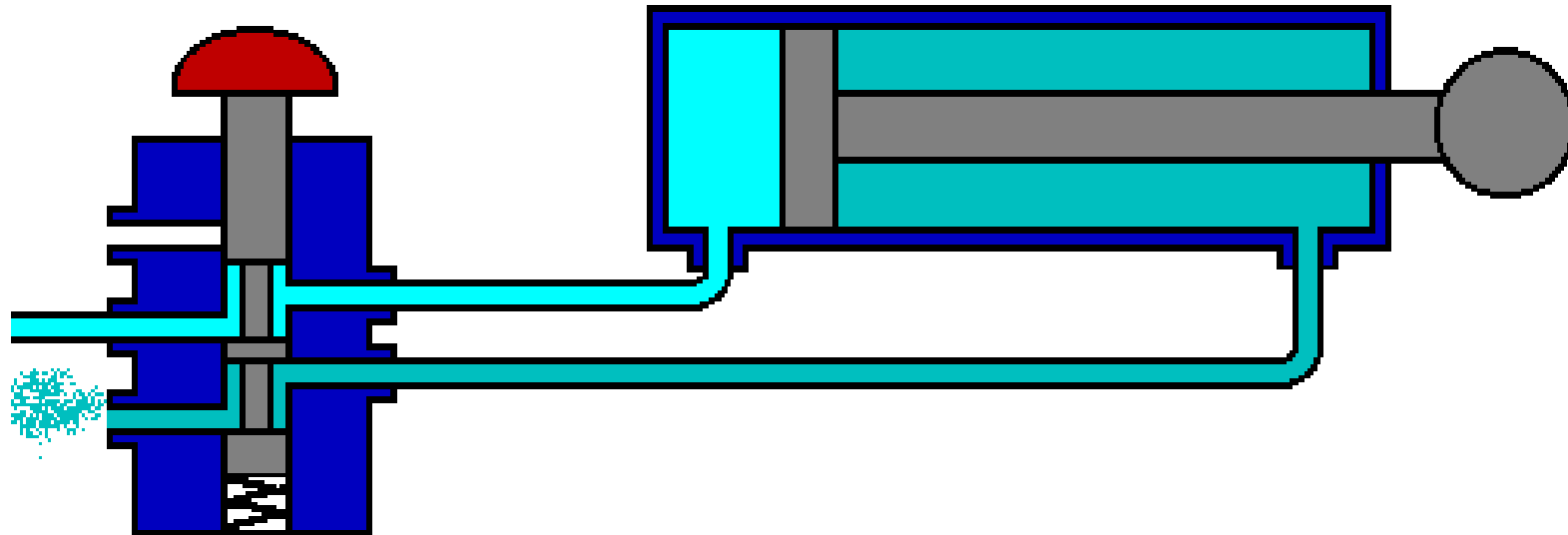
- consists of a cylinder or fluid motor that uses hydraulic power to facilitate mechanical operation
- a hydraulic actuator can exert considerable force, but is limited in acceleration and speed.

Examples



Pneumatic Actuators

- A **pneumatic actuator** converts energy (typically in the form of compressed air) into motion.



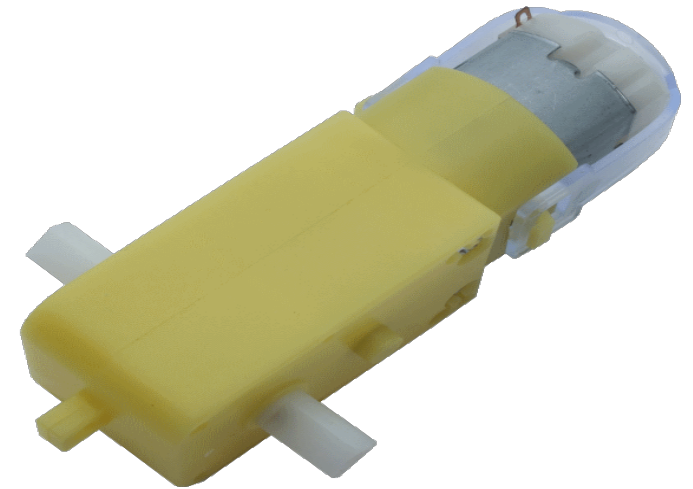
Motors

- ❑ DC MOTORS
- ❑ STEPPER MOTORS
- ❑ SERVO MOTORS
- ❑ WORM GEAR MOTORS



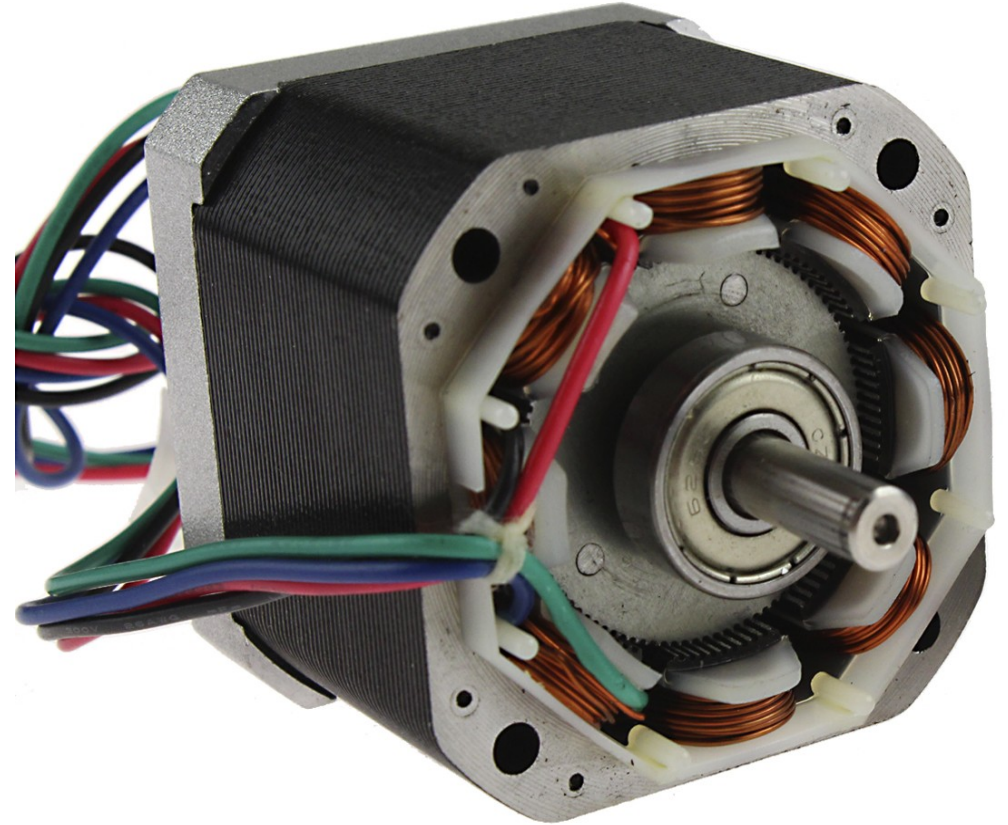
DC Motors

- These are simple motors used for simple purpose.
- Speed can be reduced by reducing the voltage supplied, however that's not an efficient way of doing things.
- Torque and speed are inversely proportional. Generally a 100rpm - 300rpm motor is used as the wheels of a robot .
- Never apply voltage more than applied voltage.
- Rated voltage is generally 6V, 12V or 24 V



Stepper Motor

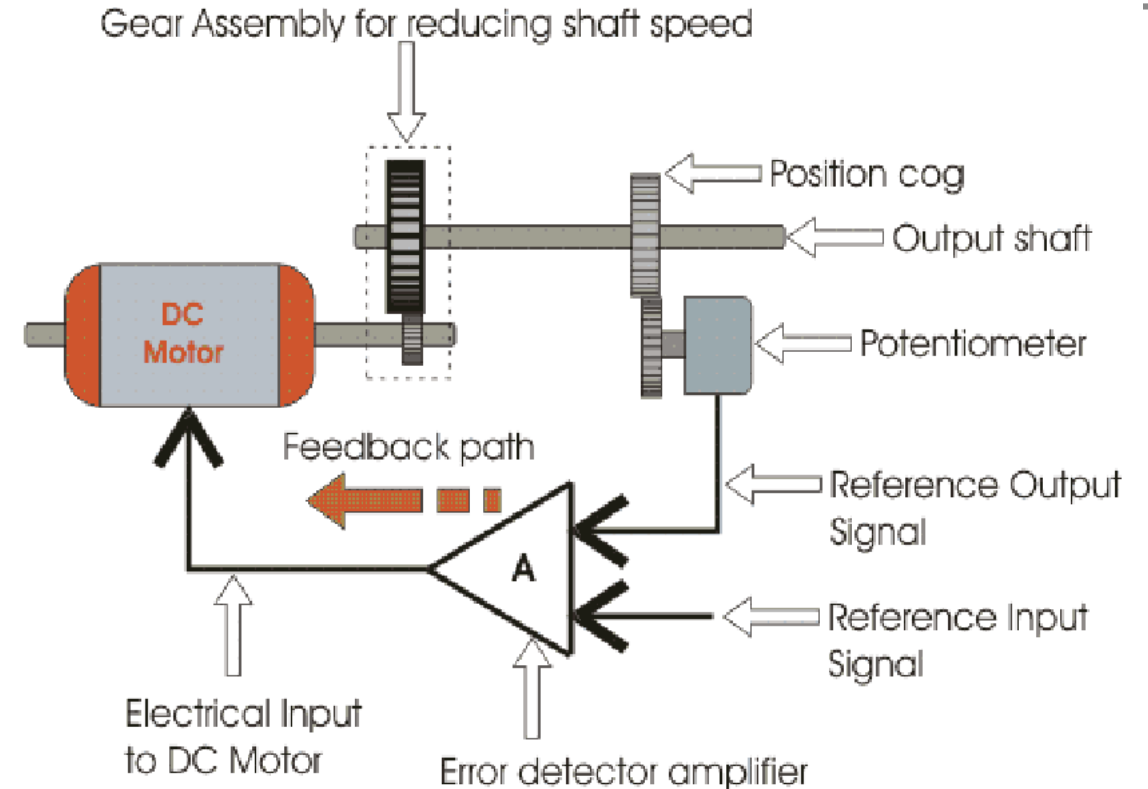
- Designed to maximize holding torque
- Accurate but slow
- No feedback mechanism installed
- Ease of control
- Completes a rotation in steps



Step	Coil 4	Coil 3	Coil 2	Coil 1	
b.1	on	on	off	off	
b.2	off	on	on	off	
b.3	off	off	on	on	
b.4	on	off	off	on	

Servo Motor

- DC motor with inbuilt feedback mechanism
- More accurate than stepper motor
- Cannot rotate more than 180 degrees
- Feedback ensures that shaft rotates accurately

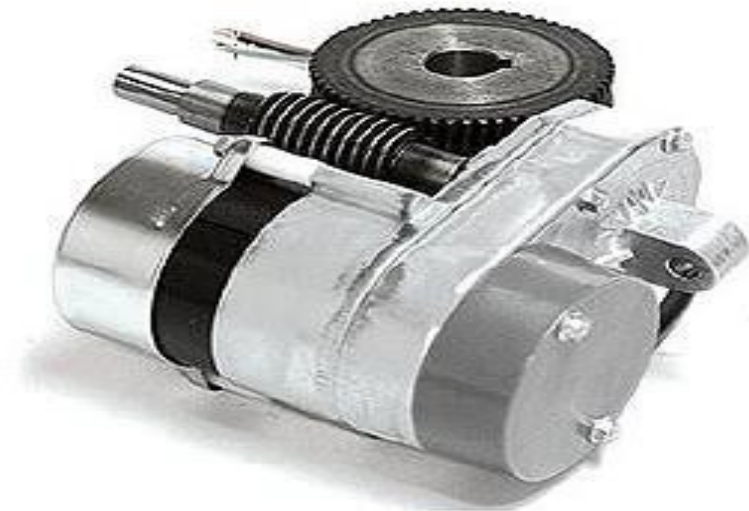


Servo motor mechanism

- The motor is paired with some type of encoder to provide position and speed
- Only the position is measured and measured position of the output is compared to the command position, the external input to the controlled feedback.
- If the output position differs from that required, an error signal is generated which then causes the motor to rotate in either direction, as needed to bring the output shaft to the appropriate position. As the positions approach, the error signal reduces to zero and the motor stops.

Worm Gear motor

- A worm drive can reduce rotational speed or allow higher torque to be transmitted.
- Used by us to lift heavy loads.
- Unidirectional power transfer



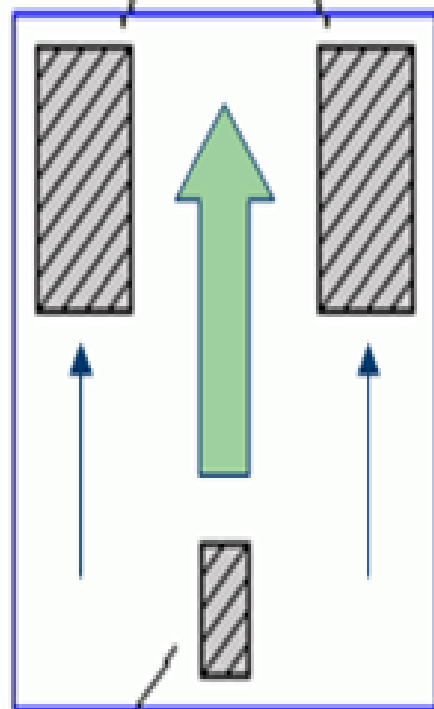
DRIVES

- Differential drives
- Steering drives
- Synchronous drives
- Skid steer drives

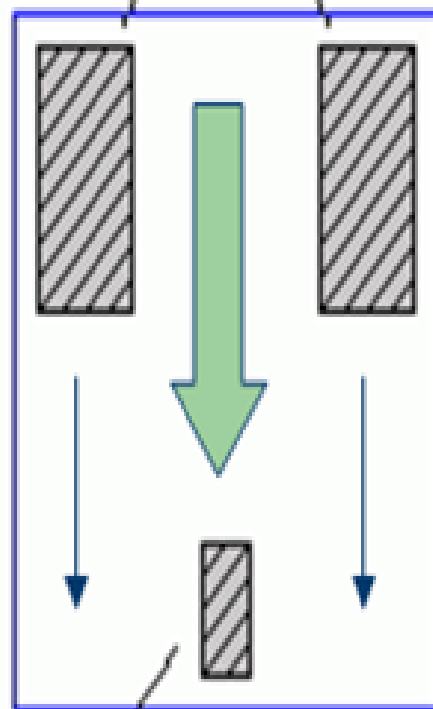
Differential Drive

- Simplest and easiest to implement
- It can also be 3 or 4 wheels drive
- 3 wheel drive has a free moving wheel accompanied with a left and right wheel . The two wheels are separately powered.
- Generating a couple
- Independent drives makes it difficult for straight line motion

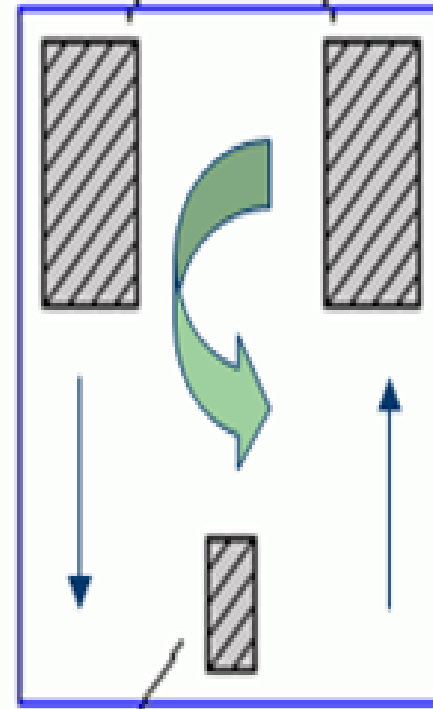
drive wheels



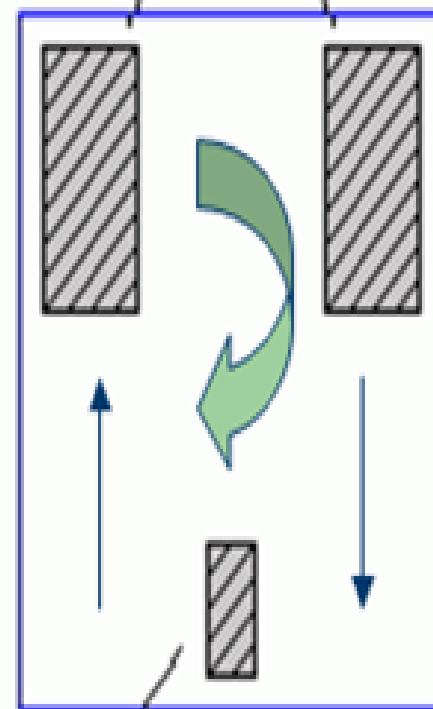
drive wheels



drive wheels



drive wheels



non-driven wheel

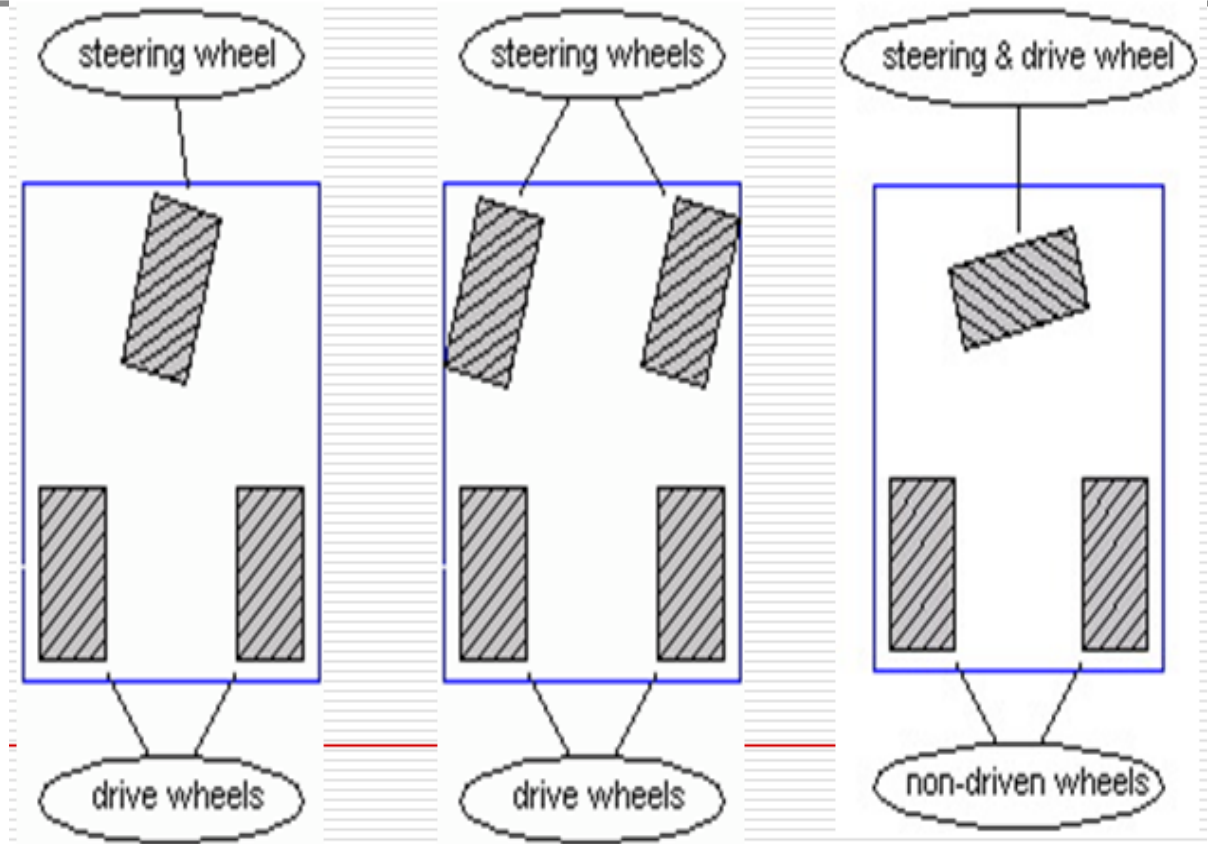
non-driven wheel

non-driven wheel

non-driven wheel

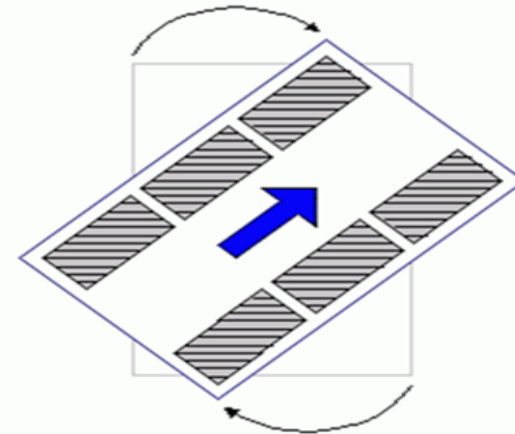
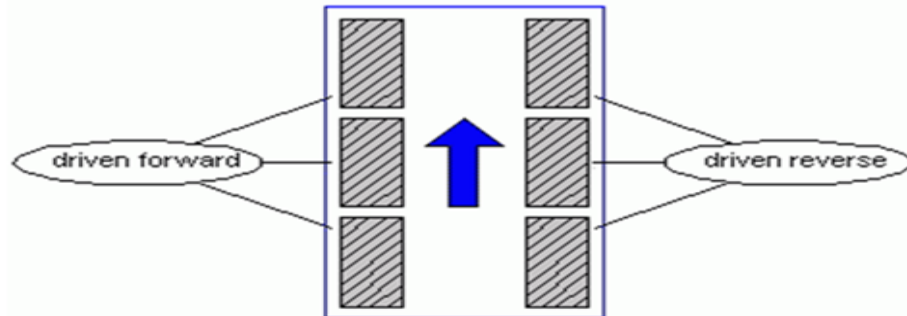
Steering

- Can be 3 or 4 wheels
- Using guiding wheels to steer the bot
- Generally used in three wheel drive
- Not effective to take a very sharp turn



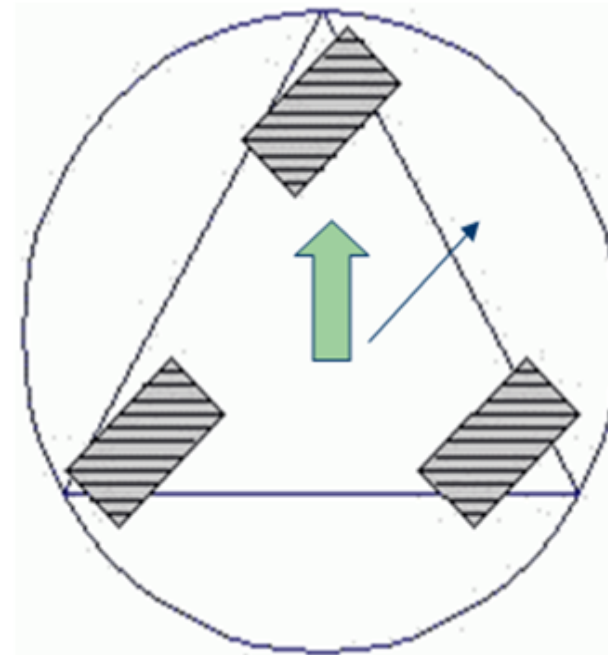
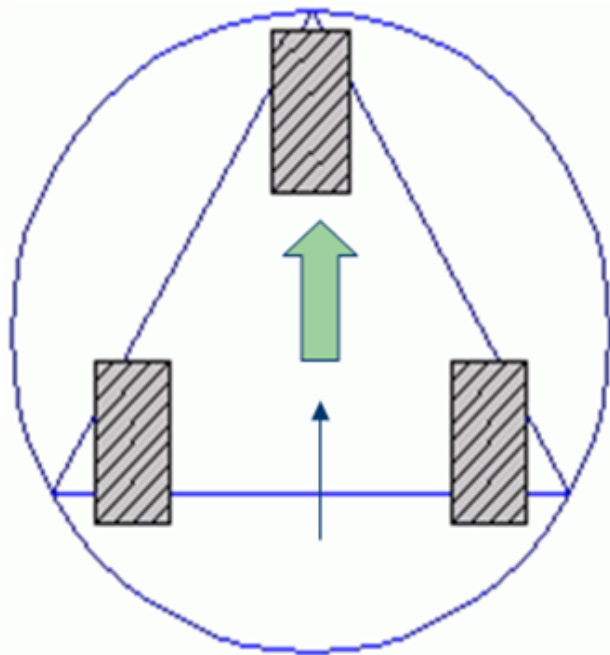
Skid Steer Drive

- It is mostly used in tracked machines e.g. tanks. Also finds application in some four/ six wheeled robots
- The left and right wheels are driven independently
- Steering is accomplished by actuating each side at a different rate or in a different direction, causing the wheels or tracks to slip or skid, on the ground



Synchronous Drive

- It is made up of system of motors. One set of which drive the wheels and the other set turns the wheels in a synchronous Drive



Mechanisms

Rigid bodies connected by joints in order to accomplish a desired force and/or motion transmission constitute a mechanism.

Gripping mechanism

Hands of a robot is referred to gripper.

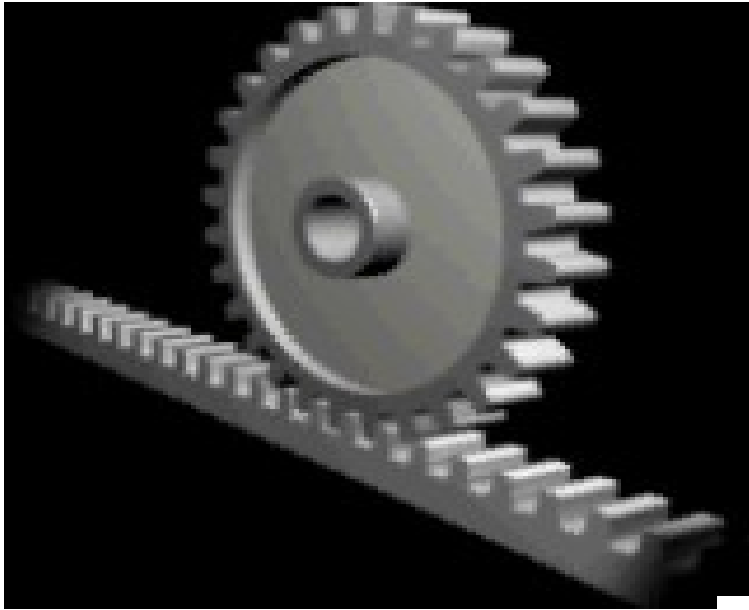
Lifting mechanism

- Will be used to lift the gripper.

Motion Transfer mechanisms

- Rotation to linear motion
 - Rack and pinion
 - Power screw
 - Conveyor belt

- Rotation to rotation motion
 - Gears(spur, bevel, worm etc.)



Rack and pinion



Power screw



Conveyer belt



Spur
gear



Worm gear

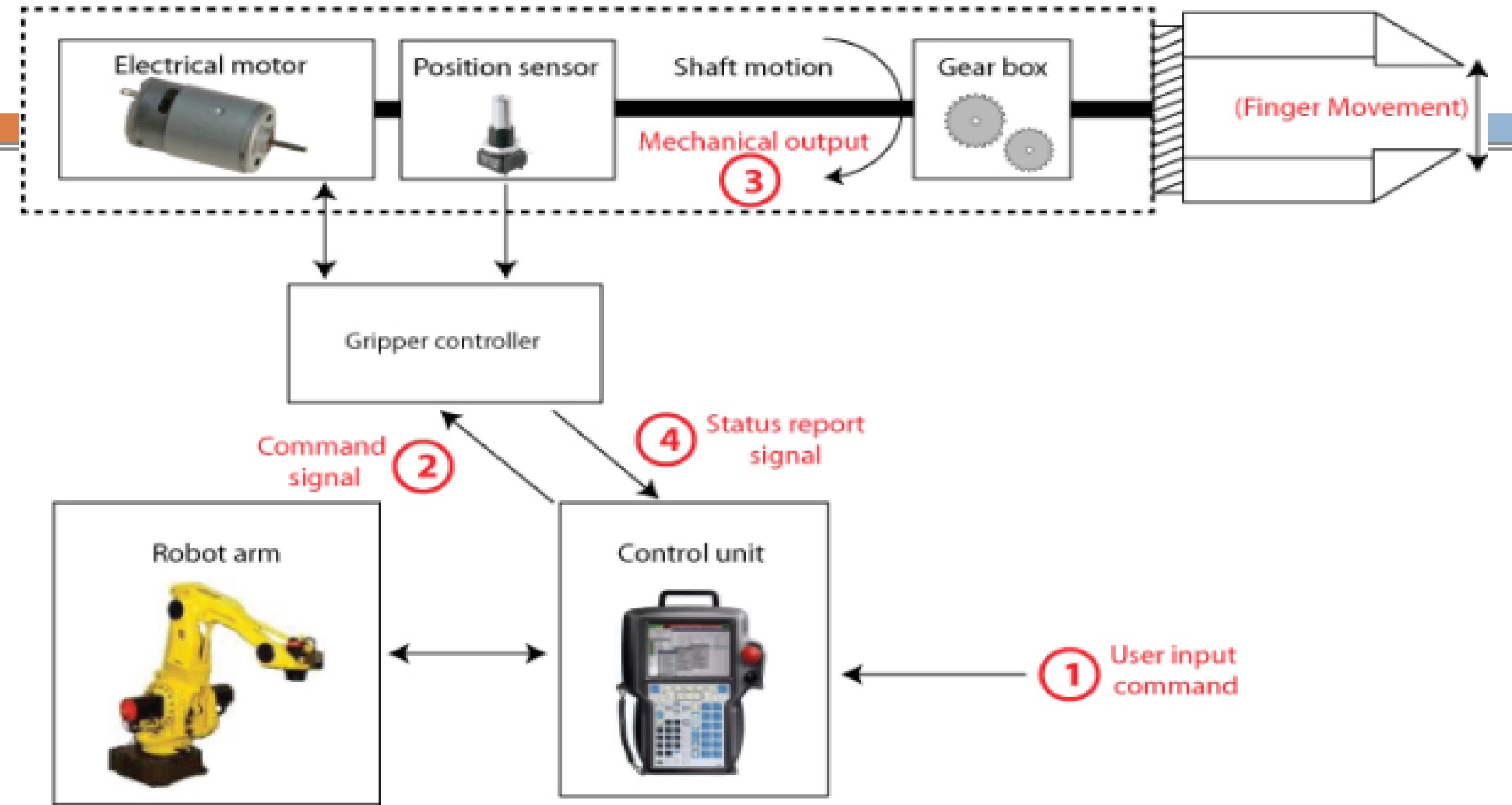


Bevel gear

GRIPPERS

- Servo-electric grippers
- Pneumatics grippers
- Hydraulic grippers
- Vacuum grippers

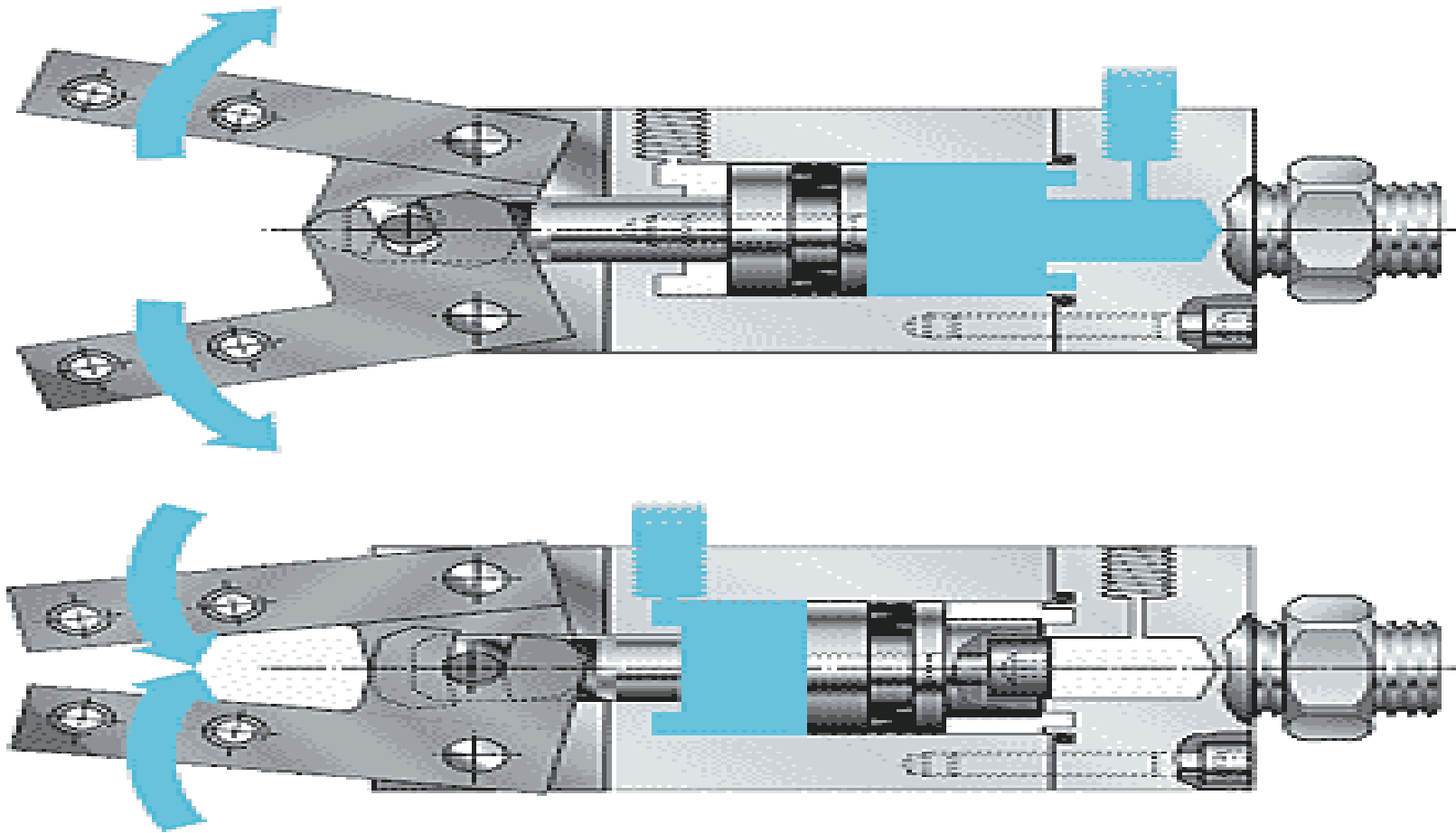
Servo-electric gripper



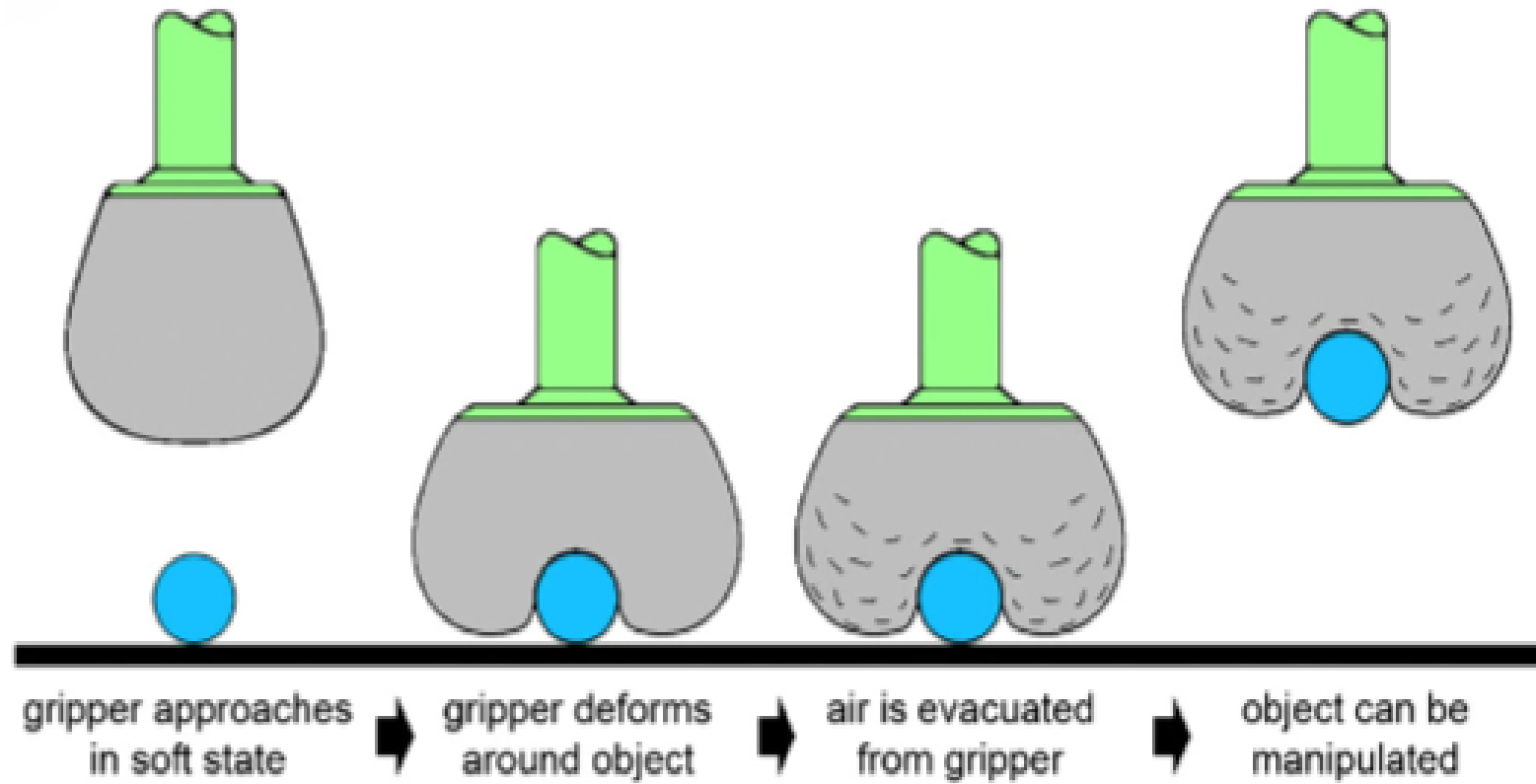


4-bar mechanism griper

Pneumatics gripper



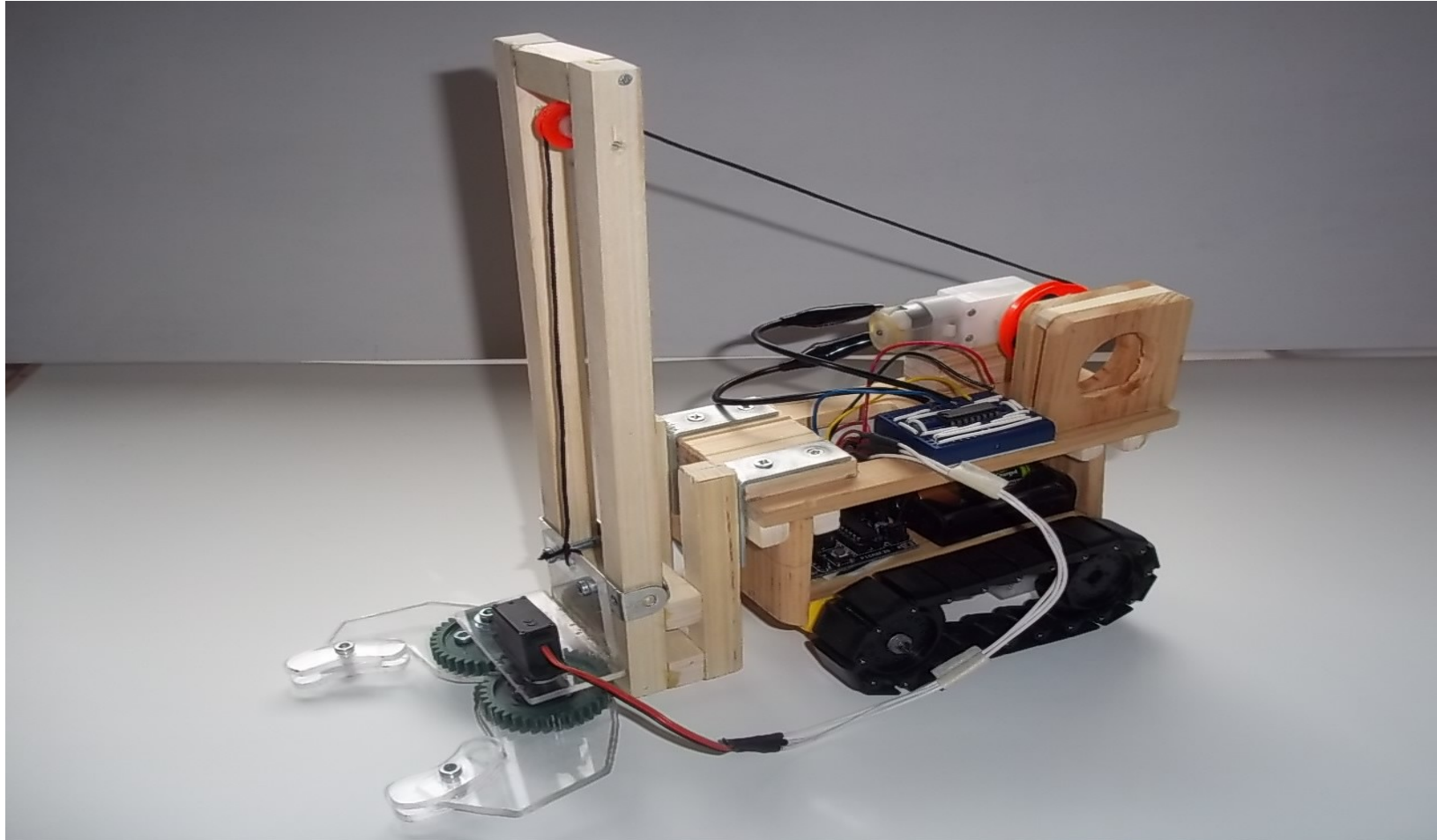
VACUUM GRIPPER



Lifting mechanisms

- Pulleys
- Sliders
- 4-Bar linkage mechanism
- Scissor mechanism

Pulley lifting mechanism



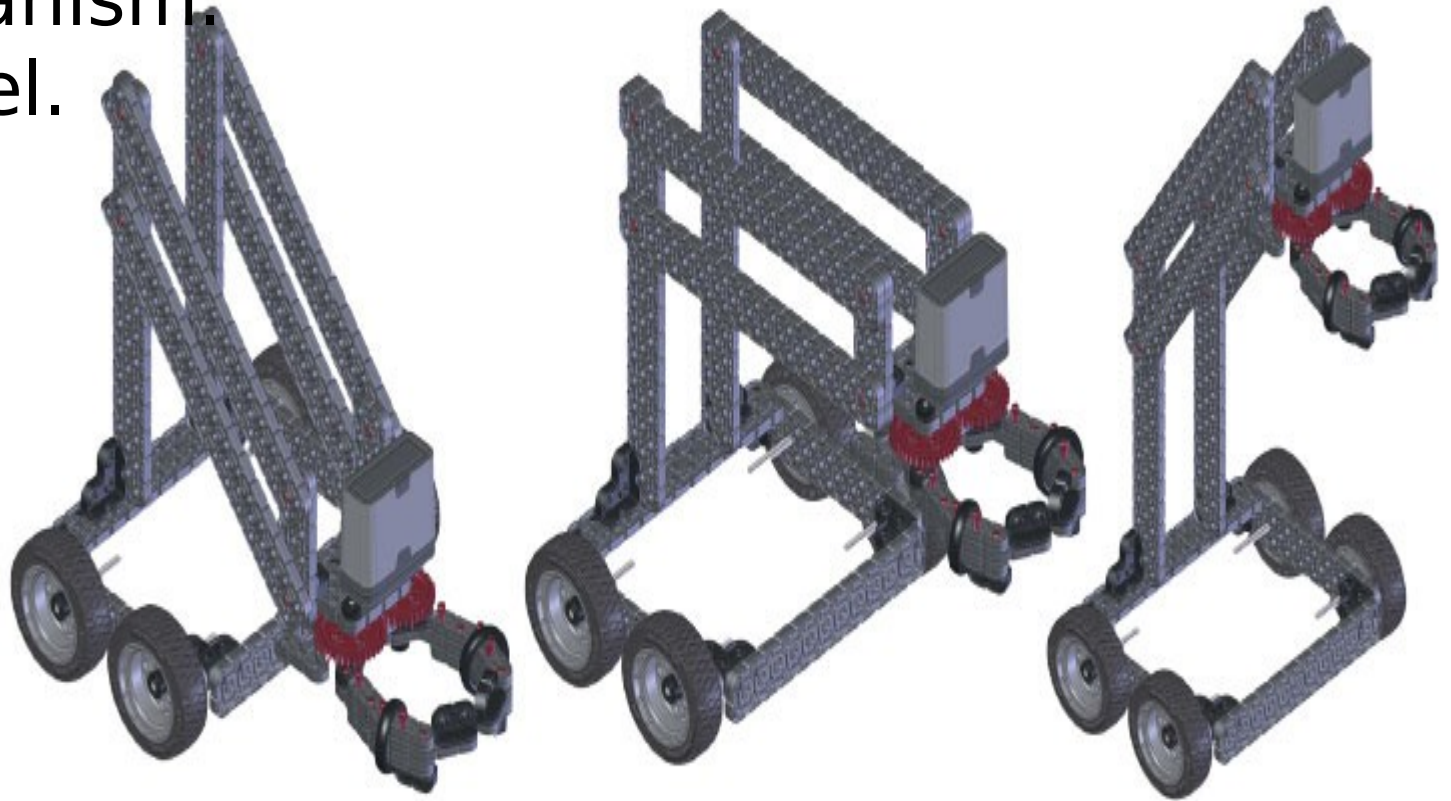
Sliders

- They move linear
- Combine pulley and sliders for lifting

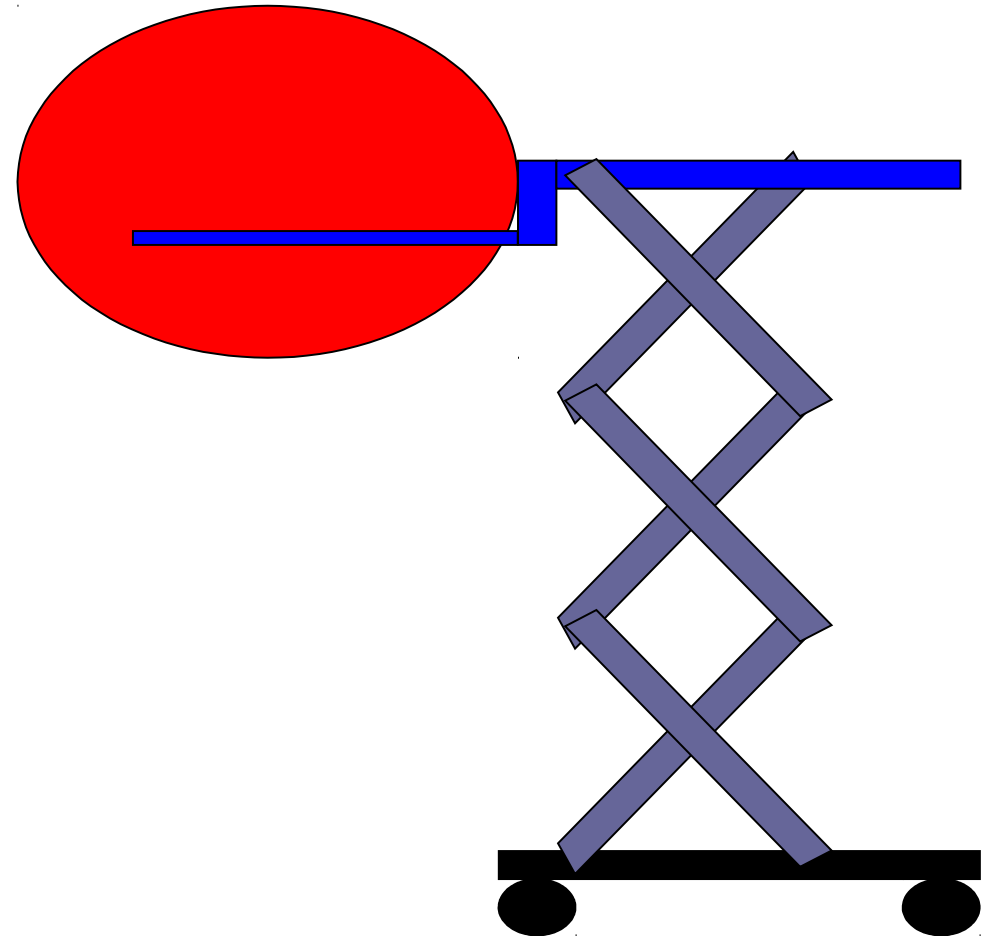
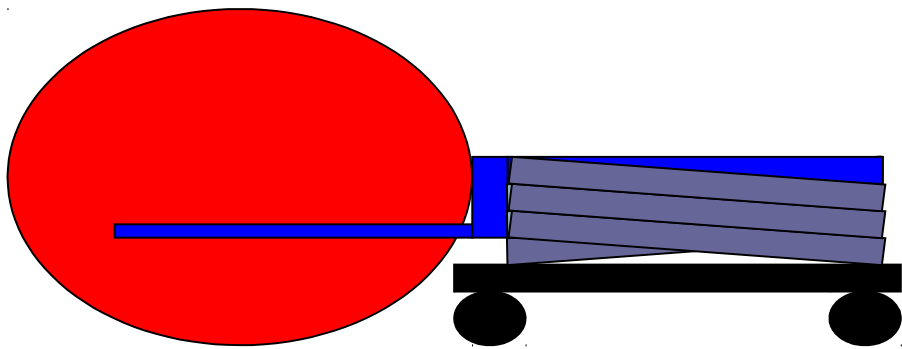


4-Bar linkage

- Parallelogram mechanism.
- Object moves parallel.



Scissor mechanism





THANK YOU