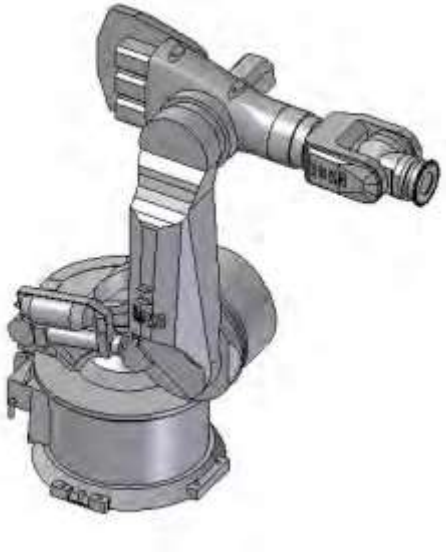
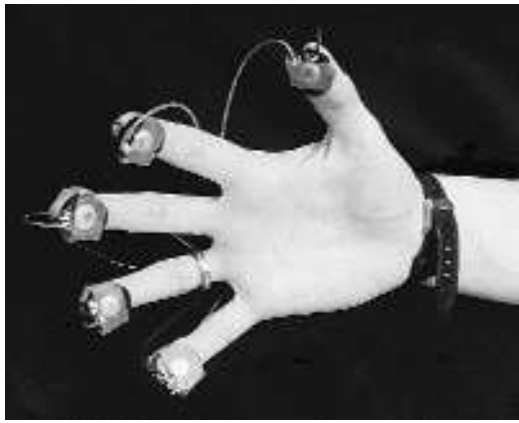
ELECTRICAL MACHINES IN ROBOTICS AND AUTOMATION

UNIT II – MOTORS AND DRIVES

Operation of Stepper motor, Servo motor, PMDC, Linear motors – control methods – driving technologies

INTRODUCTION





WHAT IS THE NEED OF MOTORS IN ROBOTICS

NEED OF MOTORS IN ROBOT

Motors are one of the primary mechanisms by which robots move.

Some motors can be attached to wheels that drive a robot around. Other motors might cause joints in a robot limb to move. Yet others might move the control surfaces of a robotic airplane or submarine.

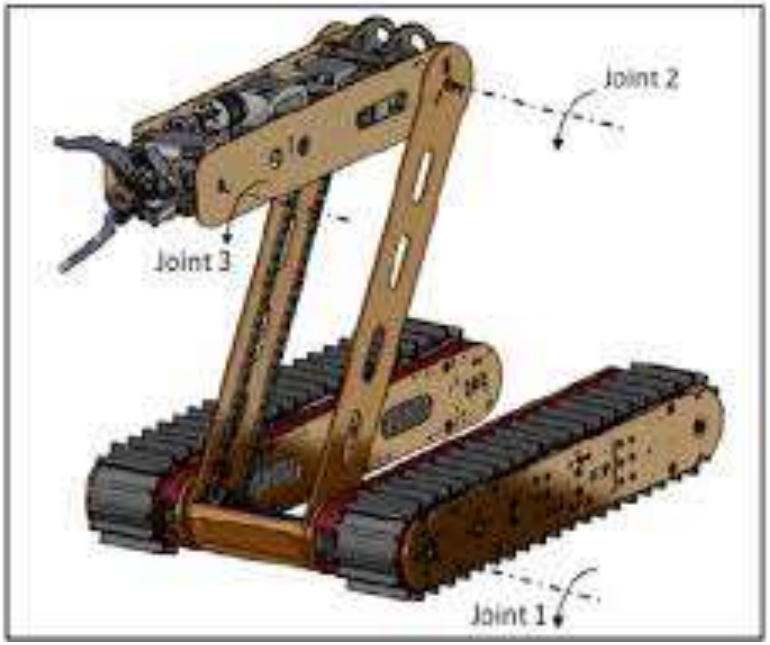
TYPES OF MOTORS USED

The huge majority of robots uses **electric motors**. Repeatedly brushless and brushed DC motors are used in portable robots and

AC motors are used in industrial robots. These motors are preferred in systems with lighter loads, and where the predominant form of motion is rotational.

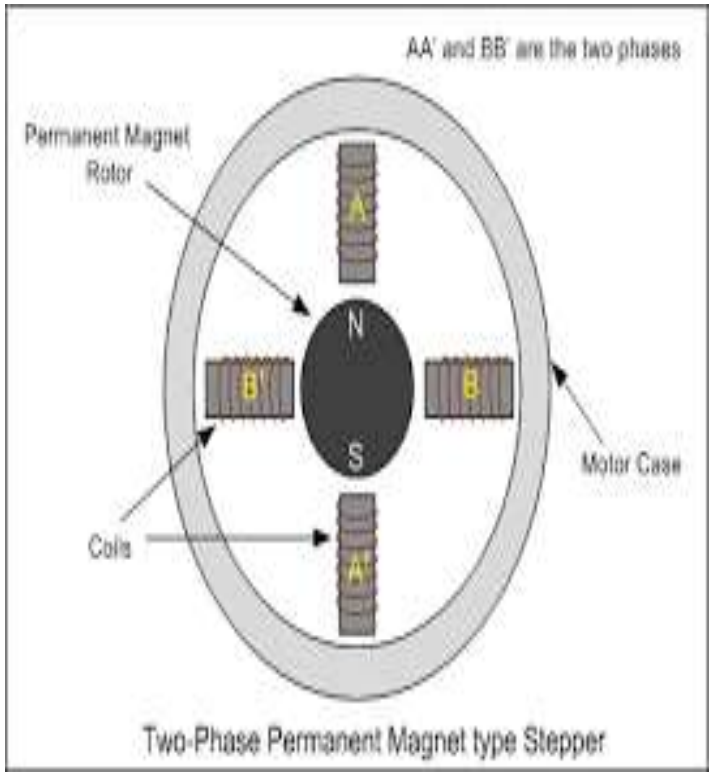
TYPES OF MOTORS USED FOR ROBOTS

- Stepper motor,
- Servo motor,
- PMDC,
- Linear motors.



STEPPER MOTOR

- Stepper motors are DC motors that divide a full rotation into a number of equal steps. One pulse causes the motor to increment one precise angle of motion.
- By energizing each step in sequence, the motor will rotate, one step at a time. Increasing the current or pulse increases motor torque, and the higher the step frequency, the higher the motor speed.
- The motor's position can be commanded to move and hold at one of these steps without any position sensor, as long as the motor is correctly sized to the application.



WORKING OF STEPPER MOTOR

The **stepper motor working principle** is Electro-Magnetism.

It includes a rotor which is made with a permanent magnet whereas a stator is with electromagnets.

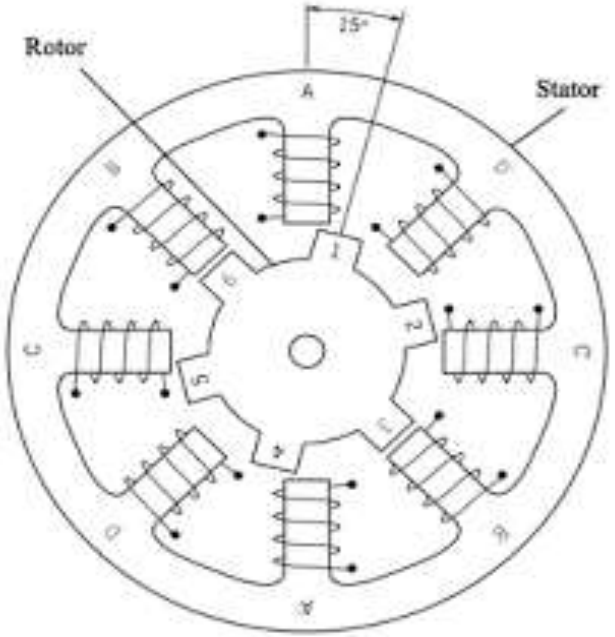
Once the supply is provided to the winding of the stator then the magnetic field will be developed within the stator.

Now rotor in the motor will start to move with the rotating magnetic field of the stator. So this is the fundamental working principle of this motor.

In this motor, there is a soft iron that is enclosed through the electromagnetic stators.

The poles of the stator as well as the rotor don't depend on the kind of stepper.

Once the stators of this motor are energized then the rotor will rotate to line up itself with the stator otherwise turns to have the least gap through the stator. In this way, the stators are activated in a series to revolve the stepper motor.



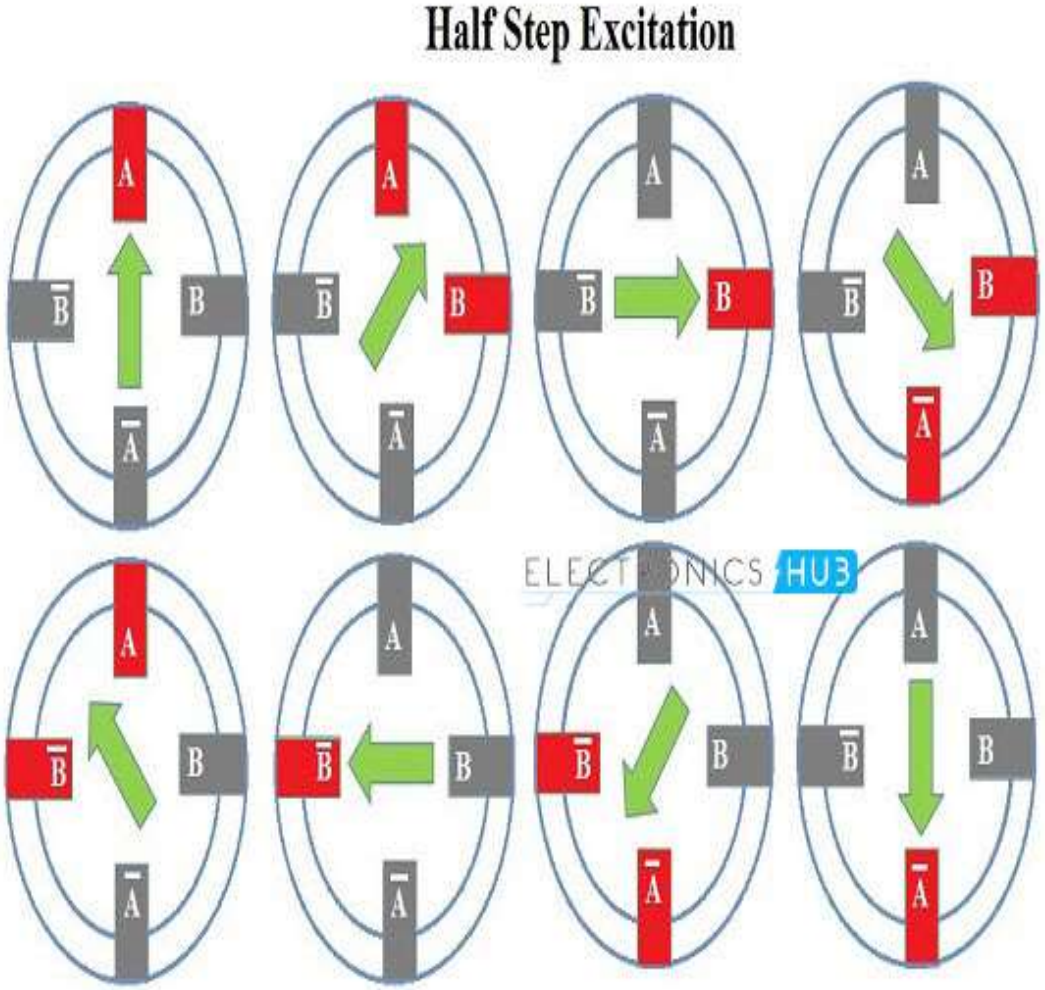
MODES OF OPERATION

- HALF STEPPING MODE
- FULL STEPPING MODE
- MICRO STEPPING MODE

Half Step Drive

- This technique is fairly related to the Full step drive because the two stators will be arranged next to each other
- so that it will be activated first whereas the third one will be activated after that.
- This kind of cycle for switching two stators first &after that third stator will drive the motor.
- This technique will result in improved resolution of the stepper motor while decreasing the torque.

HALF STEP EXCITATION



Step	Phase			
	A	B	$\bar{A}$	$\bar{B}$
1	1	0	0	0
2	1	1	0	0
3	0	1	0	0
4	0	1	1	0
5	0	0	1	0
6	0	0	1	1
7	0	0	0	1
8	1	0	0	1

FULL AND MICRO STEP EXCITATRION

Full Step Drive

In this technique, two stators are activated at a time instead of one in a very less time period.

This technique results in high torque & allows the motor to drive the high load.

Micro Stepping

This technique is most frequently used due to its accuracy.

The variable step current will supply by the stepper motor driver circuit toward stator coils within the form of a sinusoidal waveform.

The accuracy of every step can be enhanced by this small step current.

This technique is extensively used because it provides high accuracy as well as decreases operating noise to a large extent.

FULL STEP EXCITATION