

## 1.1 STEPPER MOTOR

Stepper Motors have revolutionized machinery in today's world. These motors are mostly used in 3D printers, CNC machines, Robotics etc. Stepper motor is nothing but a DC motor that moves in steps and each step can be controlled with precision. Therefore stepper Motors have high accuracy compared to other Motors also they have high torque which can handle heavy loads making it an ideal choice for machinery

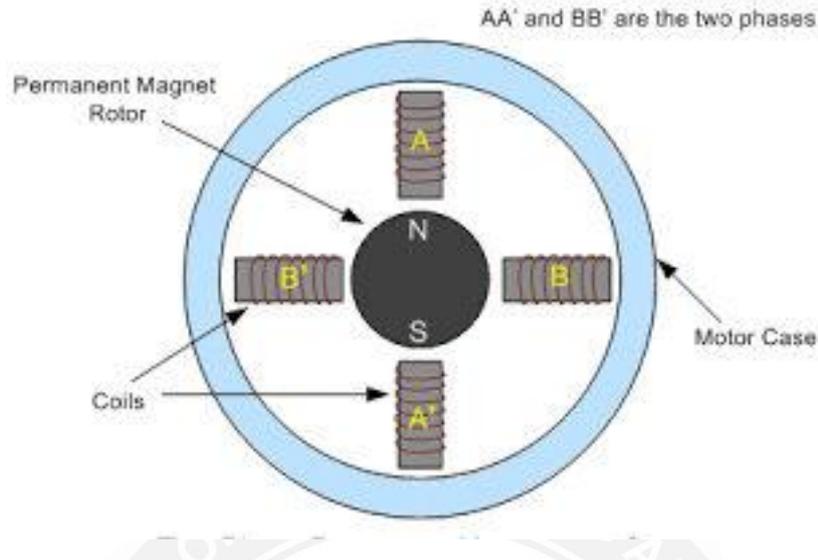
### CONSTRUCTION OF STEPPER MOTOR:

Stepper motor construction is quite similar to DC motor. It also has a permanent magnet as Rotor. Rotor will be in the center and will rotate when force is acts on it. This rotor is surrounded by a number of stator which is wound by magnetic coil all over it. Stator will be placed as close as possible to rotor so that magnetic fields in stators can influence rotor's movement. To control the stepper motor each stator will be powered one by one alternatively. In this case the stator will magnetize and act as an electromagnetic pole exerting repulsive force on the rotor and pushes it to move one step. Alternative magnetizing and demagnetizing of stators will move the rotor step by step and enable it to rotate with great control.

### TYPES OF STEPPER MOTOR BASED ON CONSTRUCTION:

There are different types of stepper motor which varies with its complexity in construction and working. In this tutorial we will see some of the basic types and its construction.

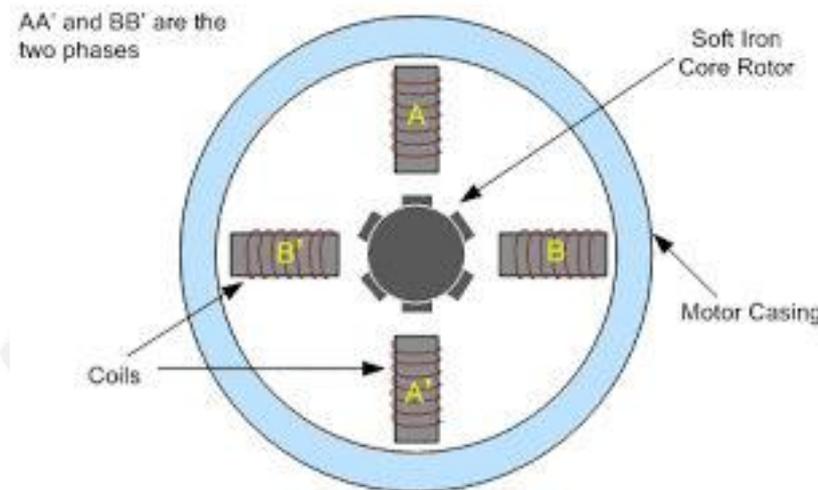
**PERMANENT MAGNET STEPPER MOTOR:**



**Figure 1.1.1 permanent magnet stepping motor**  
 [Source: "special electric machines" by E.G.Janardanan page:9]

In this motor a permanent magnet is used as Rotor and electromagnetic stators around it. This is the motor we saw in above examples. Here the stator will be magnetized and demagnetized to move the rotor and set the motor to rotation.

**VARIABLE RELUCTANCE STEPPER MOTOR:**

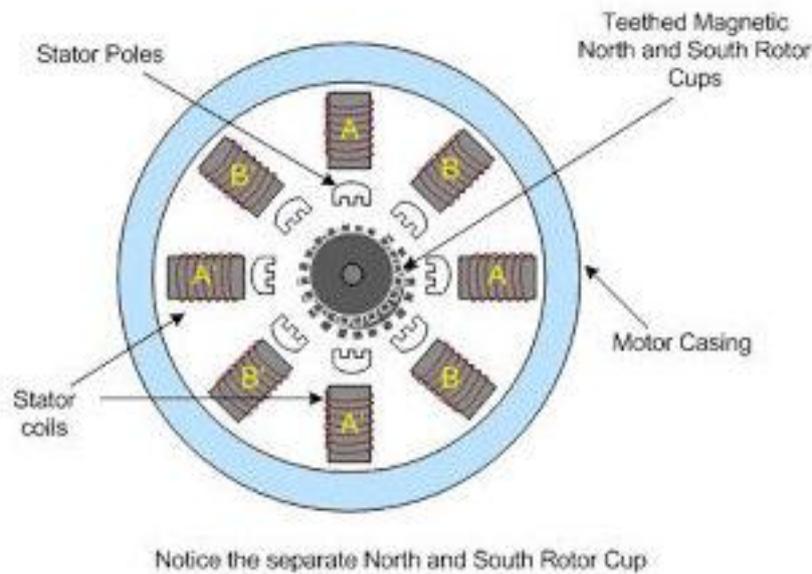


Notice that the teeth of the Rotor are so designed that when they are aligned to one phase, they get misaligned to the other

**Figure 1.1.2 variable reluctance stepper motor**  
 [Source: "special electric machines" by E.G.Janardanan page:2]

This motor is built using Ferromagnetic rotor and Electromagnetic stator with coil winding to magnetize them. Here the rotor will have multiple projections also called as teeth which will act like magnetic poles. This stepper motor works based on Magnetic reluctance hence got its name. When current passes through stator pole, it will magnetize and pulls the rotor's projecting poles in a way the distance between them is minimum and in full alignment. The driver circuit will continue to magnetize stators setting the rotor into rotation.

### HYBRID SYNCHRONOUS STEPPER MOTOR:



**figure 1.1.3 Hybrid synchronous stepper motor**

[Source: "special electric machines" by E.G.Janardanan page: 12]

This is a combination of above two motor permanent and variable reluctance stepper motor. This motor consists of permanent magnetic toothed rotor like the ones in permanent magnet stepper motor with set of north and south poles in it. Also just like variable reluctant motor the stators have teeth in it. Few teeth of stator will be aligned to teeth of rotor while others will not be aligned to each other. When stator is magnetized by supplying current to it, magnetic flux drives the rotor to move by one step. The

presence of teeth in both stator and rotor changes the magnetic flux and drives the motor by steps as intended.

The Hybrid synchronous motor is most popular since it has high torque and resolution. Driving modes like half step can even increase the resolution of this motor. While full step or micro stepping can be used to increase the torque, accuracy and smooth working. The hybrid motor is most popular because of the advantages it holds but comes with high cost due to its complex construction.

### **CHARACTERISTICS STEPPER MOTOR:**

These are some of the important characteristics you need to look for in a stepper motor.

1. Resolution
2. Rotating angle
3. Operating voltage
4. Torque
5. Speed

### **APPLICATIONS OF STEPPER MOTOR:**

1. Printers
2. CNC machines
3. 3D printers
4. Laser and optics
5. Industrial machinery