Servo Motors

What Are Servo Motors?

A **servo motor** is an electrical device which can push or rotate an object with great precision. If you want to rotate and object at some specific angles or distance, then you use servo motor. It is just made up of simple motor which run through **servo mechanism**. If motor is used is DC powered then it is called DC servo motor, and if it is AC powered motor then it is called AC servo motor. We can get a very high torque servo motor in a small and light weight packages. Doe to these features they are being used in many applications like toy car, RC helicopters and planes, Robotics, Machine etc.

Servo Mechanism

It consists of three parts:

1. Controlled device
2. Output sensor
3. Feedback system

It is a closed loop system where it uses positive feedback system to control motion and final position of the shaft. Here the device is controlled by a feedback signal generated by comparing output signal and reference input signal.

Here reference input signal is compared to reference output signal and the third signal is produces by feedback system. And this third signal acts as input signal to control device. This signal is present as long as feedback signal is generated or there is difference between reference input signal and reference output signal. So the main task of servomechanism is to maintain output of a system at desired value at presence of noises.

### **Working principle of Servo Motors**

A servo consists of a Motor (DC or AC), a potentiometer, gear assembly and a controlling circuit. First of all we use gear assembly to reduce RPM and to increase torque of motor.

Say at initial position of servo motor shaft, the position of the potentiometer knob is such that there is no electrical signal generated at the output port of the potentiometer.

Now an electrical signal is given to another input terminal of the error detector amplifier. Now difference between these two signals, one comes from potentiometer and another comes from other source, will be processed in feedback mechanism and output will be provided in term of error signal. This error signal acts as the input for motor and motor starts rotating.

Now motor shaft is connected with potentiometer and as motor rotates so the potentiometer and it will generate a signal. So as the potentiometer’s angular position changes, its output feedback signal changes.

After sometime the position of potentiometer reaches at a position that the output of potentiometer is same as external signal provided. At this condition, there will be no output signal from the amplifier to the motor input as there is no difference between external applied signal and the signal generated at potentiometer, and in this situation motor stops rotating.

Code for Servo Motor (Arduino)

1)knob

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| #include <Servo.h>  Servo myservo; // create servo object to control a servo  int potpin = 0; // analog pin used to connect the potentiometer  int val; // variable to read the value from the analog pin  void setup() {  myservo.attach(9); // attaches the servo on pin 9 to the servo object  }  void loop() {  val = analogRead(potpin); // reads the value of the potentiometer (value between 0 and 1023)  val = map(val, 0, 1023, 0, 180); // scale it to use it with the servo (value between 0 and 180)  myservo.write(val); // sets the servo position according to the scaled value  delay(15); // waits for the servo to get there  } |

2) Sweep

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| #include <Servo.h>  Servo myservo; // create servo object to control a servo  // twelve servo objects can be created on most boards  int pos = 0; // variable to store the servo position  void setup() {  myservo.attach(9); // attaches the servo on pin 9 to the servo object  }  void loop() {  for (pos = 0; pos <= 180; pos += 1) { // goes from 0 degrees to 180 degrees  // in steps of 1 degree  myservo.write(pos); // tell servo to go to position in variable 'pos'  delay(15); // waits 15ms for the servo to reach the position  }  for (pos = 180; pos >= 0; pos -= 1) { // goes from 180 degrees to 0 degrees  myservo.write(pos); // tell servo to go to position in variable 'pos'  delay(15); // waits 15ms for the servo to reach the position  }  } |

Stepper Motors

It is a [brushless](https://www.electricaltechnology.org/2016/05/bldc-brushless-dc-motor-construction-working-principle.html)electromechanical device which converts the train of electric pulses applied at their excitation windings into precisely defined step-by-step mechanical shaft rotation. The shaft of the motor rotates through a fixed angle for each discrete pulse. This rotation can be linear or angular.It gets one step movement for a single pulse input.

Types of Stepper Motor:

There are three main types of stepper motors, they are:

**Permanent Magnet Stepper Motor:**Permanent magnet motors use a permanent magnet (PM) in the rotor and operate on the attraction or repulsion between the rotor PM and the stator electromagnets.

**Variable Reluctance Stepper Motor:**Variable reluctance (VR) motors have a plain iron rotor and operate based on the principle that minimum reluctance occurs with minimum gap, hence the rotor points are attracted toward the stator magnet poles.

**Hybrid Synchronous Stepper Motor:**Hybrid stepper motors are named because they use a combination of permanent magnet (PM) and variable reluctance (VR) techniques to achieve maximum power in a small package size.

### Operation of Stepper Motor:

Stepper motors operate differently from [DC brush motors](http://www.edgefxkits.com/four-quadrant-dc-motor-control-without-microcontroller), which rotate when voltage is applied to their terminals. Stepper motors, on the other hand, effectively have multiple toothed electromagnets arranged around a central gear-shaped piece of iron. The electromagnets are energized by an external control circuit, for example a microcontroller.

To make the motor shaft turn, first one electromagnet is given power, which makes the gear’s teeth magnetically attracted to the electromagnet’s teeth. The point when the gear’s teeth are thus aligned to the first electromagnet, they are slightly offset from the next electromagnet. So when the next electromagnet is turned ON and the first is turned OFF, the gear rotates slightly to align with the next one and from there the process is repeated. Each of those slight rotations is called a step, with an integer number of steps making a full rotation. In that way, the motor can be turned by a precise. Stepper motor doesn’t rotate continuously, they rotate in steps. There are 4 coils with 90o angle between each other fixed on the stator. The stepper motor connections are determined by the way the coils are interconnected.In stepper motor, the coils are not connected together.

The motor has 90o rotation step with the coils being energized in a cyclic order, determining the shaft rotation direction. The working of this motor is shown by operating the switch. The coils are activated in series in 1 sec intervals. The shaft rotates 90o each time the next coil is activated. Its low speed torque will vary directly with current.

Coding with Arduino

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| --- |
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