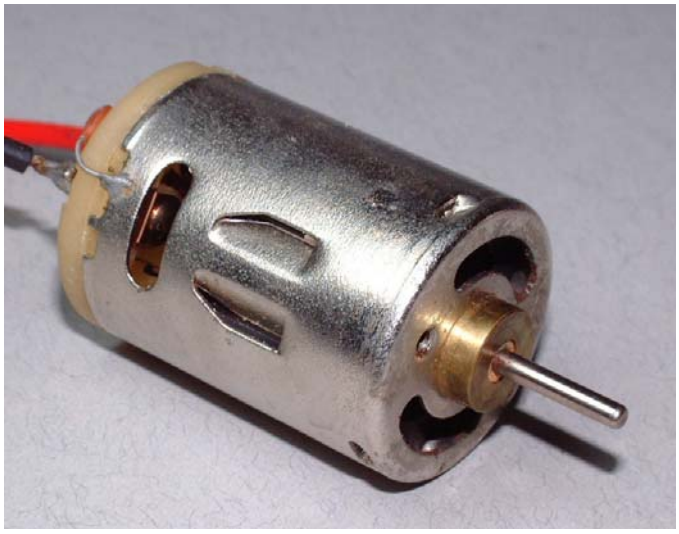
Select The Right Motor For Your Project

~ Different types of motor and their uses ~

If you want your project to have some form of movements, linking a motor to some mechanism is one effective way of achieving the purpose. Whether it is to rotate a platform, or to swing a door, or to manipulate a lever, a motor can be the power source to operate the mechanism. However, you have to select the correct type of motor to match the job. Using the wrong motor would result in under-performance and in the worse case, the project ending in a complete failure. The following is an introduction to the different types of motor and their applications.

1. DC Motor



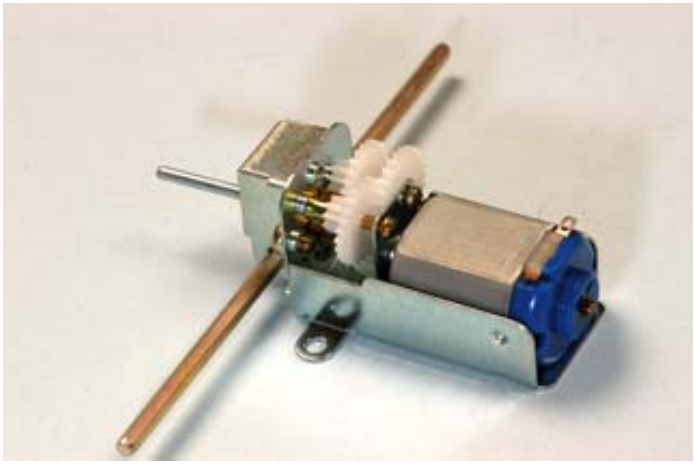
This is the most common type of small battery-operated motor that can be used for a variety of projects. The main advantage is their small size and they do not require complicated control. It can be connected directly to the rated battery voltage for simple functions. Straight from the box, a typical DC motor spins in excess of 15,000 rpm (revolution per minute), which is way too fast for most applications. To be useful, it must be geared down to the appropriate speed. Another reason for gearing down a DC Motor is to increase the tuning torque (turning power) which is required to do useful work.

Applications

Because of their small sizes and easy control, DC motors find many uses in modern appliances. They can be found cooling power supplies and CPUs in PCs and operating CD ROM drives. Printers use a few of them in each unit to feed paper to the print head. As a result, they can be found easily in used equipment and modified to for use in a project. However, it is important to note that DC motors are not very precise in their operations. Their speed can vary quite a bit even under the same operating condition. This is especially the case when they are under load.

Motor Selection

When selecting a DC motor, ask yourself the following questions:

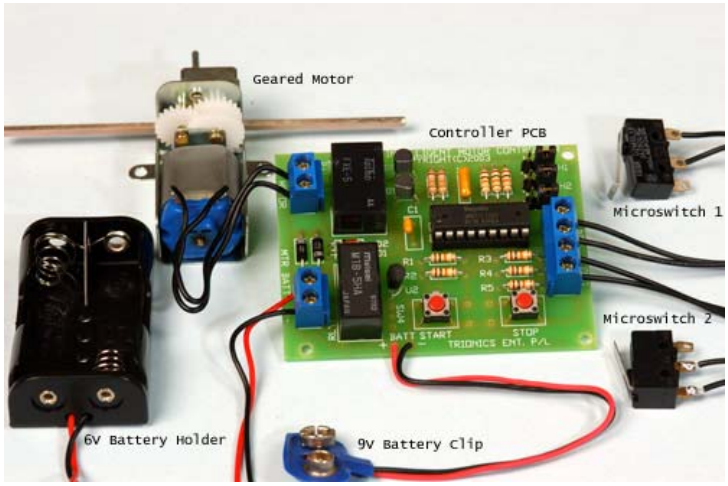


What is the load it is expected to bear? This is the turning torque of the motor and is measured in kg.cm. If the expected load is higher than the motor's rating, it would heat up very quickly when in use and will soon breakdown. This is a very common cause of motor failure in projects. Always cater for some extra allowance in your selecting the power rating. For example, if your project requires 3 kg.cm force, then choose a unit that gives 6kg.cm force. This would prevent motor failure in the event of the mechanism becoming jammed, which is quite common in the development stages.

What speed is the motor expected to turn at? Motor speed is measured in rpm. In applications where the speed is an important factor, it would have to be reduced by a series of gears. Some motors are sold with gear box with user-selectable ratios. These allow the user to select the gear ratio by interchanging the positions of the gears to arrive at a suitable speed for the output shaft. Further speed refinement can be done with an electronic speed controller.

DC Motor Control

Some kind of control circuit is required if you need the motor to do more than just spinning. An example is when a motor is used to slide a tray open and close. The motor will need to turn in one direction to open the tray and stop. This is followed by turning in the opposite direction to close the tray. The control circuit would have to accept a signal to turn the motor in one direction and reverses it when a second signal is received to close the tray.



The example cited above is relatively easy. It can be accomplished by means of some switches connected together. For more complicated movements, an intelligent controller would be required. These may include movements that return the output shaft to the original position or one that requires several stops in one revolution.

2. AC Motor

AC motors are complicated electrical equipment. They are mentioned here just so that you know that there is such a type of motor. Unlike DC motors, they cannot be powered by batteries and requires special connections to enable them to work properly. The most commonly available AC motor in small size is the synchronous motor. It spins at a constant rpm and are found in electric clocks (not battery-operated quartz).

Applications

These days, AC motors are found mostly in heavy industries like machine tools and equipment that require continuous operation like the compressor in refrigerators. Invariably, these tend to be large. Occasionally they may be used in places where speed is not an important factor. A new generation of AC (synchronous) motor has found its way into hobby uses. They provide very high speed power for electric model airplanes. Because of mass production, they have become quite economical although the complicated electronic controllers are still expensive. AC motors are not useful for most projects unless there is a specific requirement.

3. Servo

These are, strictly speaking not designed as motors like in the above categories. Servos were first used as escapement control to move valves and levers in mechanical systems. Ocean-going oil tankers make extensive use of servos to transfer crude oil to and from their bulk tanks. They have a built-in

DC motor with reduction gears to increase their operating torque. An electronic circuit controls the movement of the motor precisely. All these are housed in a single casing making servo very compact and easy to use. For application in small projects, hobby servo is an ideal source of power.

(photo - servos, inside)

Applications

Hobby servos can be used as they are or with modification. Ordinarily, they are the power houses that push and pull the elevators and ailerons of model airplanes. In recent years, they are used in robotic controls. Modified servos were first used as wheel motors because of their compact size, high power and easy control. A pair of continuous turning servos can easily power a 5 kg mobile robot. There are now purpose-made units for robotic applications. These have higher power output and very precise displacement control. Many find applications in moving limbs and sensors. Hobby servos can be linked to levers or cranks to effect useful movements in a project.

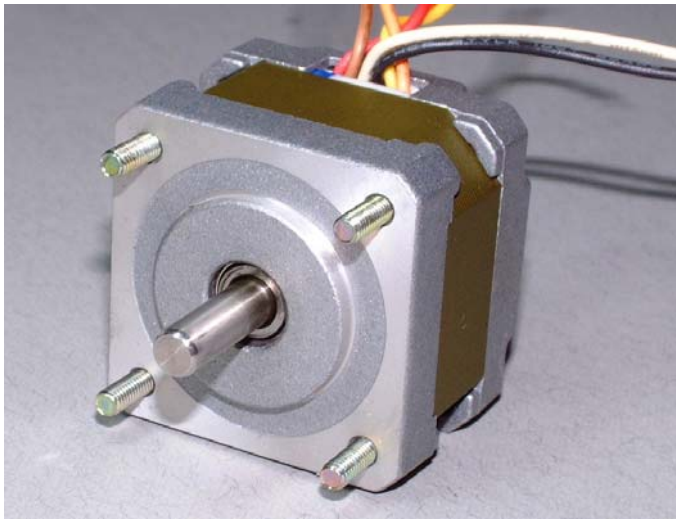
(photo – door mech, mobile robot, brat)

Servo Selection
As in DC motor, servos come with different power rating. They range from 1.5 to 12 kg.cm, varying also in physical size and battery consumption. Servos are more tolerant to overload because of the built-in reduction gears and sometimes current-limiting capability. The end result of using an underpowered servo is a stalled movement, usually without serious damage to the servo. It is still advisable to use a higher power servo for any application to cater for friction and mechanical losses doe to sloppy linkages.

Servo Control
Servo can only be controlled by a servo controller designed for the purpose. The use of other types of controller can result in a damaged servo. There is a three-wire cable attached to all hobby servos. This cable must be connected to the controller in the right direction. The standard unmodified servo can move its output disc within limits, usually 100 degrees. The disc can be set to move between different angles and external linkages can be attached to the servo output to activate other mechanisms. Modified servos have their internal mechanical stops removed so that the motor can spin without restriction. In this case, the controller only controls the rotational speed. This is usually within a very limited range.

4. Stepper Motor

Of all the motors considered so far, the stepper motor offers the greatest precision in term of displacement. However, they are inherently slow and bulky (and heavy) for the same power rating. A series of magnetic windings are placed around the casing (stator) at regular interval. Permanent magnets are attached on the rotor (the central spinning part) with no external electrical contact. The rotor therefore is free wheeling. Electric current is passed through the stator windings sequentially to cause the rotor to spin or to displace a specific angle and hold its position. A stepper motor with an appropriate controller can be expensive. You may want to consider the cost effective before deciding on using one.
(photo – stepper, small and big)



Applications
The stepper motor is the motor of choice in controlling the position of print heads in printers and laser sensor in CD ROM drives. These applications require very precise positioning of mechanical parts within a system. Except in the special areas of robotics, stepper motors are not very useful for general project because of their low torque and complicated control set-up.
(photo – CD ROM, printer)

Stepper Motor Control
Special electronic controllers are used to control the movement of steppers. Depending on the motor used, the unit angle of displacement, speed and total displacement can be controlled. Steppers have the unique quality of holding a rotor position without damaged.