

## Choosing the Right Arduino Motor

In this Arduino motor guide, we'll cover the basic information you need to know before choosing a motor for your project. If you've been working on [DIY electronics](#) for a while now and you're feeling fairly confident in your abilities, you may be looking to up the challenge and reward, by working on bigger, better and more complex inventions. When it comes to advanced builds, motor-driven creations such as robots based on Arduino are often among the most popular; and with good reason, they're pretty awesome!

There are a lot of different types of Arduino motors to choose from and each has their own strengths and weaknesses. For that reason, you'll find that not every motor is ideal for every task, with some excelling in certain areas but not really cutting it in others. Today we will be taking a close look at some of the many types of electric motors that you're likely to come across when [shopping for your electronics](#), along with some tips on how, when and where to use to use a particular motor to make sure you've always got the right kit for the job based on what you need your new motorized project to do.

And for some inspiration, we'll also be taking a quick look at some of the motorized builds we've put together to help get your creativity flowing, as well as demonstrating the functionality of some of the motors we'll be looking at. So if you're an aspiring creator looking to get the low down on Arduino motor systems so that you can take your builds to the next level, then you're definitely in the right place.

## Arduino Motor Types

### Servo Motors

Servo motors are among the most popular motors used by hobbyists who require motor functionality when working on their Arduino projects. The reason for their popularity is the fact that servo motors are immensely versatile electric motors.

A servo motor is a short name for a regular DC motor coupled to a sensor for position feedback and a small control board. This makes it easy to control the motor right out of the box, through your Arduino using a PWM signal. Servo motors are top choice among hobbyists and are used extensively throughout the modern industry and particularly in robotics where they have proved highly adept at providing fine motor control for robotic limbs as well as mechanized prosthetics used by amputees.



How it works

A servo motor in general terms can be a linear or rotary actuator, which is to say that it is capable of precise control of a linear or angular motion. It is not in point of fact, a single motor type by itself, but is instead a combination of a motor, control circuit and sensor for positional feedback combined into a single working unit.

#### Servo motor control

While some servos are designed to operate based on analog impulses, those commonly found in the [hobbyist marketplaces](#) are much more likely to be PWM controlled servos that are designed to work with the microcontrollers. With the help of a motor driver/amplifier, the Arduino (which in the control circuit is referred to as the indexer) controls the order of electrical impulses that are sent to the motor via the amplifier.

#### Pros

Servos are extremely versatile

Easy to control and program via digital output

High Precision – not all

does not require control loop computations

Available in many variants allowing for additional functionality such as greater rotational control

#### Cons

High power draw

Tends to be more expensive than simple motors

Due to popularity and high costs, many servos using plastic gearing are available at much lower prices, however, these are not suitable for heavy loads or extended usage and are prone to become stripped (toothless over time)

[Start a Servo Motor Circuit](#)

#### DC Motors

While it may be a bit outdated, the standard Direct Current (DC) brushed motor is as simple as they come. Easy to assemble and cheap to make, they are found filling practically every role where electric motors are called for.



#### How it works

The DC brushed motor consists of an odd numbered set of conductive windings arranged around a central axle to which the commutator is attached. The outer assembly contains two magnets with opposite polarities. As the windings are energized they are charged and begin to get attracted towards the outer assembly resulting in rotation. This charge is altered as the brushes come in contact with the commutator and so allows the windings to continue to experience attraction towards the outer assembly, allowing the motor to rotate as long as power is provided.

#### DC motor control

As you'd expect, simple motors are simple to control. In terms of power, increasing voltage or amperage can adjust the motor speed of rotation (RPMs) or Torque respectively. To reverse the direction of the motor, a simple polarity reversal of the motor contacts is all that is required.

To achieve the greater precision demanded in modern applications, DC brushed motors may be paired to a device called a wheel encoder/ Rotary encoder. These devices are able to read and sense the angular position of a motor's axle and later the microcontroller converts the output signal into digital information. This data can be used to determine location, motor speed and acceleration of the motor it is attached to.

#### Pros

High torque

Simple assembly and easy to control

Extremely cheap to manufacture

#### Cons

Wear and tear on brushes reduces its lifespan

Prolonged usage at higher RPM can cause brush heating and damage to the motor

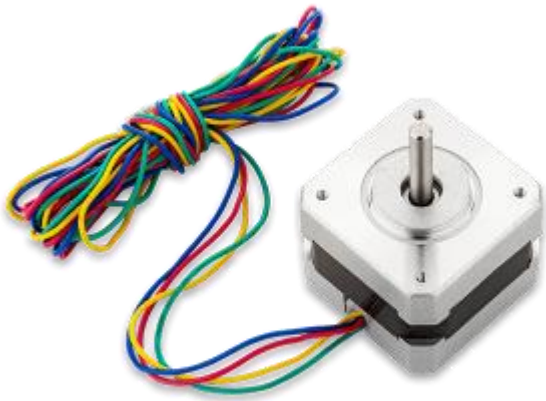
Small amounts of electromagnetic interference on radio frequencies

demands more computation for closed loop control

[Start a DC Motor Circuit](#)

#### Stepper Motor

A variant of the regular DC motor, the stepper motor is the go-to choice when you need a motor capable of tightly controlled movements to provide precision beyond the capabilities of a standard motor. They are commonly used in the printing industry as well in simple robots such as factory robot arms configured for specific tasks.



### How does this motor work

Unlike other motors which are intended to provide unlimited rotation when in use, stepper motors are designed to move a particular number of 'steps' at a particular speed when powered up. With each charge of the motor providing enough power for a single step. How small each 'step' indicates the overall accuracy capability of the motor.

#### Stepper motor control

Unlike other motor types, the stepper motor is designed for use with more advanced electronics in order to take advantage of the fine motor control that it is capable of. For that reason, stepper motors require a driver circuit which connects it to a control system (such as an Arduino) capable of regulating power to the motor.

#### Pros

Extremely high precision control over the operation

Simplicity of construction and reliability

High torque – not all

Open loop control

#### Cons

Highly specialized usage

Requires advanced control system for proper operation

[Start a Stepper Motor Circuit](#)

#### Brushless Motor

An evolution of the brushed motor, brushless motors are quickly becoming the motor of choice for many hobbyists and enthusiasts owing to the immense potential and improved reliability over their predecessors. Like brushed motors, they provide a good deal of torque as well as being able to operate reliably at high RPM. This makes the brushless motor extremely versatile, very capable as an Arduino Motor and particularly popular with those building RC cars or drones.



### How it works

The brushless motor uses an alternating current to create opposite charges between the windings and the magnets on the outer assembly. In this design only the outer assembly attached to the axle rotates; the benefit of having only a single moving part combined with removing the need for contact brushes is that brushless motors enjoy higher energy efficiency, longer operational lifetimes, smooth delivery of mechanical energy to the axle and low friction.

### Brushless motor control

While harder to control than a simple brushed motor, the use of modern technology has made them much more simple to control via computers. [Hall effect sensors](#), which can detect changes to magnetic fields and translate that into digital information are often used with brushless motors to monitor and control their output, just like wheel encoders are used with brushed motors.

### Pros

Long lifespan

Single moving part provides high reliability

Low friction construction advantageous for extended operation at high speed

Energy efficiency

### Cons

Requires specialized control systems

For optimal motor usage, requires the use of a gearbox regulate power delivery

[Start a Brushless Motor Circuit](#)

### Parameters for choosing an Arduino motor

Choosing the right motor for your project will often depend on the type of project you're attempting to build and what performance indicators will determine the ideal motor for you. There are three main parameters that are co-dependent, that we need to take into consideration when choosing the right motor for our project

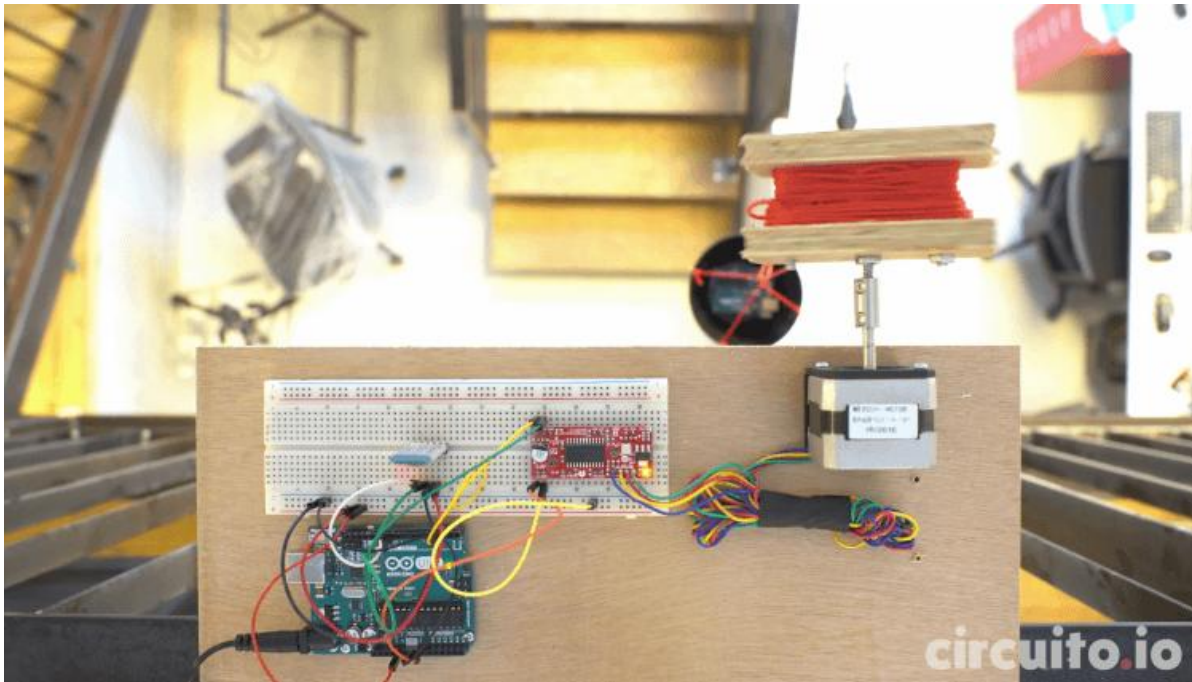
Torque

While we won't be delving into serious math and physics in this article, an understanding of your motor's torque rating and how it influences your decisions when picking out your projects motor is important, in order to make sure you select a motor that meets your needs or expectations adequately.

Simply put, a motor's Torque rating is the amount of rotational force that your motor is capable of exerting on a load. Torque is determined by a simple formula:

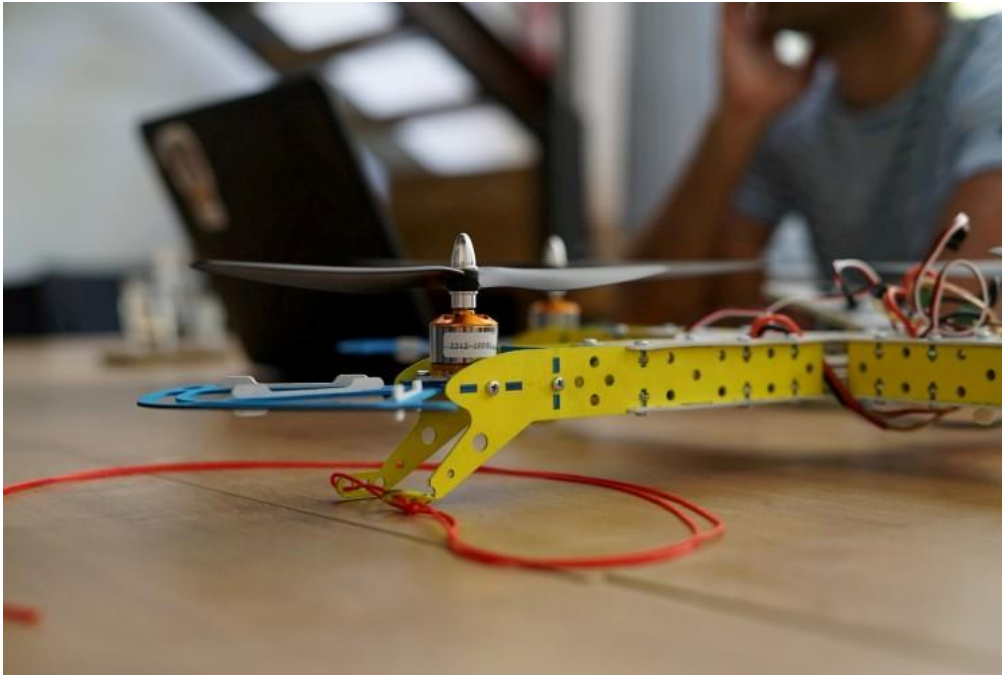
Torque = Distance from axis of rotation X Force

For an example of how torque affects your creations, we can look at another field where torque is important, the automotive sector. When ascending hills or steep roads, an engine with a high torque rating is preferable as it is able to apply greater force to the load (the vehicle) allowing it to travel up the hill even at low speeds or a standing start.



A high torque rating is important for maintaining high rotational motor speed such as in a drone. A high torque motor can change RPM values quickly, an ability which should translate into smoother more responsive performance from an electric vehicle using such a motor. Good options for those looking for high torque motors are a standard DC brushed motors which, while cheap, has a shorter lifespan and requires more maintenance or a more expensive but more reliable and energy efficient DC brushless motor.

Keeping your motors torque rating in line with your creation's needs is important to ensure long-term operation as a torque rating that is too low makes your creation inoperable, while a torque rating that's too high could cause mechanical stress during operation. While the risk of catastrophic failure due to excessively high torque ratings is low when it comes to DIY electronics, it can still cause parts to wear out faster than they should and shorten the operational lifespan of your new invention.



### Voltage – Velocity/RPM

In this context, Velocity is the speed at which the electric motor rotates. This angular rotational speed is measured in revolutions per minute or RPM and along with torque are the two main factors that influence motor performance. In slightly oversimplified terms, where a high torque motor is good at moving heavier loads at a slow speed, a high RPM drive system will allow for higher speeds while reducing your overall load carrying capacity.

When adding an Arduino motor to the project you need to take into consideration your power supply- wall or batteries and make sure that the motor voltage characteristics are met in order to get the most out of it.

For advanced builders, a gearbox, similar to those used in regular cars allows motors to function well in both capacities as the need arises. As those of you who drive will already know, lower gears give you plenty of torque to start moving but you need to quickly change up to 2nd and 3rd gear to maintain acceleration. And if you've ever tried moving from a standing start in a high gear, say 4th or 5th on a manual transmission, you'll know how a high RPM without sufficient torque or inertial momentum is going to get you nowhere quickly.

In general, a brushless motor is a great option for those who want a reasonable torque along with reliability and energy efficiency even at higher RPMs but are not interested in dealing with the weight and complexity of a gearbox.

### Current/Amperage

When choosing an electric motor, it's important to select one that is able to provide the power you need while still keeping its power draw within acceptable limits. Wattage (electric power) is Volts X Amps. While the voltage is linked to increasing a motor's RPMs, likewise a higher amp rating is needed to increase torque. While having a powerful motor rated for high voltage, high amp operation, this translates into heavier power load requirements.

While this is unlikely to affect projects that rely on power from wall sockets, projects that are intended to be more portable such as unmanned vehicles, robots and wearables will have to take the motors requirements into account as the batteries powering the project will need to be set up to provide sufficient power. For this reason, motors that are as small, light and efficient as possible are always favored when it comes to developing portable electronics in order to minimize power draw and weight (both of the motor itself and the size of the power source needed to operate it).

There are many other factors that go into picking out the right motor, but having a good understanding of these 3 main criteria should be enough to steer you in the right direction. While any electric motor can, in theory, be

adapted to serve practically any function with a bit of ingenuity, you should now have everything you need to pick out the optimal motor/s that best suit your project.

