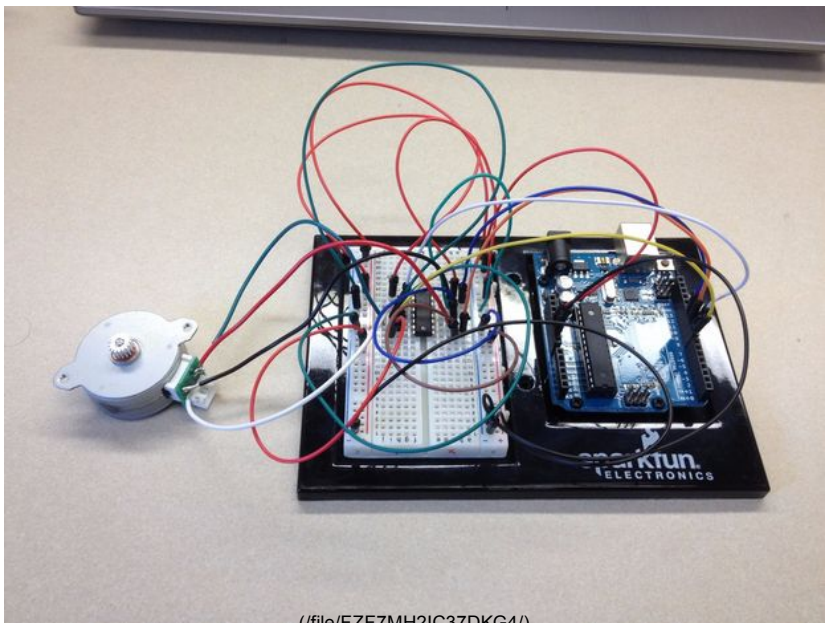
Controlling a Stepper Motor With an Arduino by

Maximous (/member/Maximous/) in arduino (/tag/type-id/category-technology/channel-arduino/)



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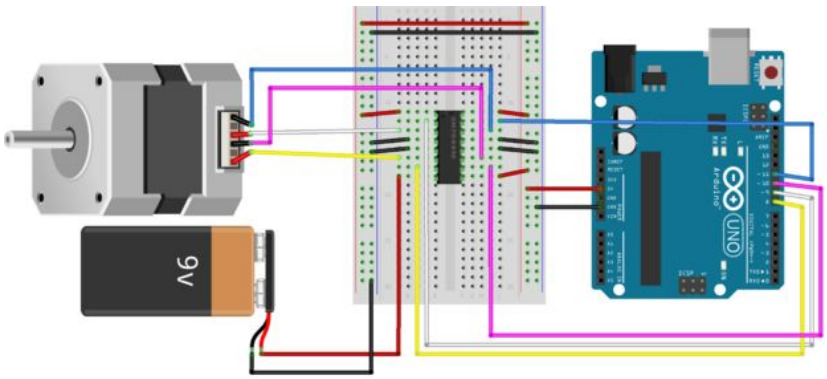

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This tutorial will show you how to operate a stepper motor that was salvaged from an old printer with an Arduino.

Step 1: What Is a Stepper Motor?

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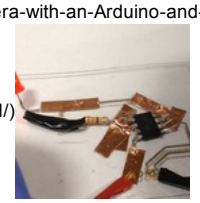
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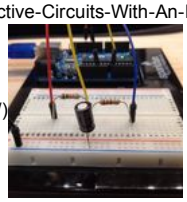
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Arduino Stepper Motors (/id/Arduino-Stepper-Motors/)
by cornelam (/member/cornelam/)

A stepper motor consists of two main parts, a rotor and a stator. The rotor is the part of the motor that actually spins and provides work. The stator is the stationary part of the motor that houses the rotor. In a stepper motor, the rotor is a permanent magnet. The stator consists of multiple coils that act as electromagnets when an electrical current is passed through them. The electromagnetic coil will cause the rotor to align with it when charged. The rotor is propelled by alternating which coil has a current running through it.

Stepper motors have a number of benefits. They are cheap and easy to use. When there is no current send to the motor, the steppers firmly hold their position. Stepper motors can also rotate without limits and change direction based on the polarity provided.

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VinhT17 (/member/VinhT17) a year ago Reply

If I used a stepper motor to pull back a spring. Will it be able to completely release the spring, and will it also rotate as fast the spring travels?

DonovanG (/member/DonovanG) ▸ VinhT17 (/member/VinhT17) Reply

4 months ago

Only if you turn off the motor entirely. So in theory is should work, that means if you want a solid state system you would want to use MOSFETS and that will be a good system.

R Jordan Kreindler (/member/R Jordan Kreindler) 5 months ago Reply

Thank you for taking the time to post this interesting and informative Instructable.

The very best.

pachytrance (/member/pachytrance) a year ago Reply

Thanks

SomePolishGuy (/member/SomePolishGuy) a year ago Reply

Oh Cool!

tttapa (/member/tttapa) 2 years ago Reply

You can't just connect a stepper (or any other motor for that matter) directly to an Arduino's outputs. You should always use transistors, mostfets or H-bridges. The output pins of the Arduino can only deliver 40mA, while a typical stepper can draw up to several hundreds of milliamps. This is especially the case at lower step speeds, or under load. It might work for some time, with such a small stepper, at high speeds and with no heavy load connected, but you will almost certainly fry your Arduino. Just use a 10kΩ resistor and a NPN-transistor like the BD139, with a normal rectifier diode between collector and emitter (negative side to collector) to protect the transistor from high voltage peaks caused by self-inductance in the coils of the stepper. You could also use an N-channel

mosfet, with a 1MΩ pull down resistor from gate to ground, and a diode between the source and drain. Those few extra components are a better option than destroying your Arduino, I think ;)

kavish laxkar (/member/kavish laxkar) ▸ tttapa (/member/tttapa) Reply

2 years ago

is it necessary to use protection diode even we r using ln293d ic.?

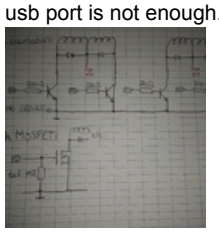
onlycparra (/member/onlycparra) ▸ tttapa (/member/tttapa) 2 years ago Reply

Hi, tttapa,

How can I do what you say? I need to do something like this instructable, but certainly with that part you say. The problem is that I have no too much knowledge about electronic. If you could show me how to do (for dummies) that amplifying step, I would be very grateful. Thanks

tttapa (/member/tttapa) ▸ onlycparra (/member/onlycparra) 2 years ago Reply

If you have a stepper with five or six wires, you'll need a circuit like this. Otherwise you'll need an H-bridge ic, or build an H-bridge yourself. If you search for 'h bridge bipolar stepper motor' on google images, you'll find plenty of examples. Assuming you have one with 5 or six wires, you need to determine which one(s) the 'common' connections are. Those are the wires in the middle (see schematic). You can look it up in the datasheet of your particular motor, or find out by measuring the resistance. To amplify the signal from the Arduino, you'll need a transistor or MOSFET, and resistors (to limit the current from the Arduino). The diodes are there to prevent the very high voltage peaks, caused by self inductance in the motor, from damaging the transistors. Keep in mind that steppers draw a lot of current, even when idle, so you'll probably need a heatsink for your transistors. Since they are more efficient, MOSFETs don't need this. You also need a decent power supply. The 100mA supplies by the Arduino's usb port is not enough.



(https://cdn.instructables.com/FPY/0VRW/IBAAKPY1/FPY0VRWIBAAKPY1.LARGE.jpg)

kavish laxkar (/member/kavish laxkar) ▸ tttapa (/member/tttapa) Reply

2 years ago

well thnks for knowlege.....now here can i use any N-channel mosfet....or sometng different....I HAVE....P55NF06....it wiil work.?

Maximous (/member/Maximous) (author) ▸ tttapa (/member/tttapa) Reply

2 years ago

You are absolutely correct. That would definitely be the best way to utilize a stepper motor with an Arduino. I did some quick calculations and with the simple task I was using it for, I didn't feel like it was necessary to add the extra safety precautions. Thanks for the great advice though.

dmwatkins (/member/dmwatkins) ▸ Maximous (/member/Maximous) Reply

2 years ago

I was going to point that out, but you already acknowledged it. Good intro to steppers though. And I have to say, this is a well written and very visually appealing Instructable! Well done!

Maximous (/member/Maximous) (author) ▸ dmwatkins (/member/dmwatkins)

2 years ago Reply

Thank you so much. It's always good to hear that others are finding my tutorials helpful.

hind244 (/member/hind244) ▸ tttapa (/member/tttapa) 2 years ago Reply

Thanks for an advice about safety coil for stepper. I felt, that a direct connection of stepper to Arduico can cause a problem with a ports burned uot become available of high current, dmanded by a motor. Can you draw a diagram of correct connectuon?

tttapa (/member/tttapa) ▸ tttapa (/member/tttapa) 2 years ago Reply

For this kind of stepper, you probably need an H-bridge. It's a bipolar stepper, and that relies on connecting the right wires to the ground or to the V+. With single transistors you can only control whether it's connected to the V+ or not. This does work for unipolar steppers though, they have one or two wires to connect directly to the ground. (5 or 6 in total). Just for the sake of completeness :)

kavish laxkar (/member/kavish laxkar) 2 years ago Reply

is it necessary to use protection diode even we r using ln293d ic.?

domints (/member/domints) 2 years ago Reply

Please, NO! Do NOT connect things like motors, relays and so on directly to the Arduino. And even if it works for you, do NOT instruct others to do so. It is highly dangerous for your arduino. The most dangerous thing is back EMF when you disconnect inductive load, which can be even few kV high - pretty easily can damage any microcontroller.
Moreover such load draws current. Loads of current. Arduino can safely drive maximum 20mA per pin. Stepper motors have typical resistance about 50Ohms. but might be much more or much less. When you drive such motor from Arduino, which is powered by 5V, it can suck even 5/50 = 0.1 = 100mA of current! 5 times more than it is allowed!!! You're very lucky, that your Ino is still alive! ALWAYS use transistors, and for inductive load, clamping diodes!

kavish laxkar (/member/kavish laxkar) ▸ domints (/member/domints) Reply

2 years ago

in this case wat i have to do....i have connected base to arduino ..and colletor to +6v and emitter to motor and then gnd..is it ok..? plz rply.

Maximous (/member/Maximous) (author) ▸ domints (/member/domints) Reply

2 years ago

This was already discussed in the comments, but thank you for your advice. You are correct that this is not the best option for your Arduino's safety.

Antzy Carmasaic (/member/Antzy Carmasaic) 2 years ago Reply

As everyone is saying, this is one of the best ways to burn your arduino. If the motor current draw doesn't kill it, the kickback on coil deactivation will. So instead of only providing criticism, I'll provide solutions for those confused on how to do it properly.

1. For unipolar stepper motor(with 5 or more wires), a cheap ULN2003A transistor array can be used. Tutorial: http://www.arduino.cc/en/Tutorial/StepperUnipolar (http://www.arduino.cc/en/Tutorial/StepperUnipolar)

2. For bipolar stepper motor(with 4 wires) use the famous L293D H-bridge IC. Adafruit tutorial on controlling a stepper with L293D:

https://learn.adafruit.com/adafruit-arduino-lesson... (https://learn.adafruit.com/adafruit-arduino-lesson-16-stepper-motors/overview)

rjohnson65 (/member/rjohnson65) 2 years ago Reply

Well Bootloaded ATMega328P-PU chips are cheap enough, the last I bought cost me $3.98 Ea.. from Amazon .

Mainly because I chose not to wait 3 weeks to get them from Shenzhen CN.

"Best Practice" means little to those who have no idea of "Practice"

Docedison

rjohnson65 (/member/rjohnson65) 2 years ago Reply

The "Surge Current" of a stepper motor is WAY beyond the output capacity of an Arduino Uno..

Typically .5 - 2A

I do wonder what mechanical loading was used to verify the motors operational capacity..

I also have doubts about the Arduino Uno's stability, when attempting to use the stepper motor..

Docedison

diy_bloke (/member/diy_bloke) 2 years ago Reply

sticking in the wires at random is making it difficult for yourself. Even without a manual, you can take out most of the guesswork by taking an ohm meter and measuring what coils belong together.
So then you know which pairs go where and at most you have to switch the wires from one pair that is better than having to try some 16 possibilities (or was it 4! =24?)

diy_bloke (/member/diy_bloke) 2 years ago Reply

I have a stepper salvaged from a HP printer. Have not used it yet as I recall it needed quite some current. But most steppers need more current than can safely be sourced directly from your Arduini pins. Would definitely advise a ULN2003 or L293

marcelo.goncalves.1466126 (/member/marcelo.goncalves.1466126) Reply

2 years ago

I approve this assembly, think very interesting , just did not like the part connecting the direct Arduino engine , for reason burn digital output , as stated in the datasheet , the Atmega 328P microcontroller port does not support more than 40 milli- ampers delivery of power supply , the rest this work is very good , congratulations !

lewac (/member/lewac) 2 years ago Reply

can't make anything constructive with arduino stuff. for example, no debugger (and that's just for openers). check out the gantry of my PnP machine. driven by a Microchip MCU. You're looking at both the A & Z axis using 200 steps per revolution steppers. btw this ain't no toy (0.002" accuracy on all 4 axis). the machine also runs at a max speed of 1440 inches per minute. finally see those PCB's there in the left foreground? 88 components placed in under 3 minutes ready for the oven.

mduarte4 (/member/mduarte4) 2 years ago Reply

Never use an microcontroler directly to motor!!!!!

* This is meant to be a basic demonstration of a stepper motor. The best practice would be to utilize an H-bridge, Transistor, or Motor Shield when connecting any motor to an Arduino. This will help prevent the motor from overloading and frying your Arduino.

dollarseed (/member/dollarseed) 2 years ago Reply

One thing you didn't mention, which should be said: "Always shut down the power to the Arduino Board, before disconnecting or connecting any wires". There is a good chance of burning out the board, if you make changes while it is powered up. Otherwise, a very good, very basic instructable that may help many :)

JaunS (/member/JaunS) 2 years ago Reply

Hello, I have built all the hardware: physical structure, and have completed in entering the GRBLtoArduino and all the software. I have used the Universal GCodeSender and has successfully interpreted the software for is says " Grbl 0.8c ['$' for help] ". I've soldered the stepper motors (for I'm using steppers from dvd roms) to some salvages wire from a printer I took apart. I installed some female sockets in order to connect to the male pins on the CNC Shield ver. 2.01 . The orange light from the arduino flashes and in the Universal GCodeSender ver. 0.8 completes the operation b/c is says " ok " . I have no idea whats wrong. I know the steppers work b/c ive used a 9v battery to pulse the motors and they do indeed pulse. Ive used a multimeter to check its resistance and it works. I've checked the current on the motors once connected to the cnc shield and there's current. I have tested if the drivers are in fact getting power and they are. I've attempted the code " x=100 " , " $7=225 " but no motor movement. Can ANYONE help me ?

Maximous (/member/Maximous) (author) ▸ JaunS (/member/JaunS) Reply

2 years ago

I'm afraid that I have not used the Universal GCodeSender before so I do not know all the details of your code. However, if the code seems to compile and load correctly and you've tested the motors, it may be a simple wiring problem. Do the motors vibrate or anything when you try to run it? Or are they completely motionless?

JaunS (/member/JaunS) ▸ Maximous (/member/Maximous) 2 years ago Reply

Motionless. Howecer I've used a 9v battery to check if it would pulse and they do. Could it be that my power supply doesn't have sufficient amps? It's 1 amp.

Maximous (/member/Maximous) (author) ▸ JaunS (/member/JaunS) Reply

2 years ago

I would check the data sheet for the Arduino model you are using. The Arduino Uno for example can only have a max output of 40 mA per I/O pin. Otherwise you would have to have the stepper motor draw the current from an external power source. If your stepper motor has a model number on it then I would google that and check it's data sheet as well.

JaunS (/member/JaunS) ▸ Maximous (/member/Maximous) 2 years ago Reply

Yeah I have an external supply of 12 v 1amp. Many say that it's the drivers that don't have enough amps . Is that tru ?

Maximous (/member/Maximous) (author) ▸ JaunS (/member/JaunS) Reply

2 years ago

Just to clarify, your external supply is connected directly to the stepper motor correct? Or it is attached to the arduino first and then the arduino is attached to the stepper motor? And I don't think I fully understand your question. The drivers of what?

JaunS (/member/JaunS) ▸ Maximous (/member/Maximous) 2 years ago Reply

http://www.google.com/aclk?sa=L&ai=CJsz-qXyHVaT4NI-BpgOz94LwAfGztc4F2bbRvMcBgan9z8cCCAkQCSCTsvocKAlgyQbIAQeqBCdP0H5Zn-8nCy2RGxssLtJDpd5Y6at1JbsN_jZke57RBi9VKVjH5ZTABQWgBibYBgKAB9uAjhWIBwGQBwKoB6a-G9gHAeASuJnqi9frloEe&sig=AOD64_2evuLIOGMoGPIUt-AH-xntmPFwwg&adurl=http://rover.ebay.com/rover/1/711-117182-37290-0/2%3Fmtid%3D1588%26kwid%3D1%26crlp%3D53601919689_324272%26itemid%3D251941874243%26targetid%3D87946122369

This is similar to what I have. You connect the stepper motors to their driver, the drivers to the CNC shield and then the shield to the arduino. The poser supply is connected to the terminals on the shield lanes " +\-" .

chuck767 (/member/chuck767) ▸ JaunS (/member/JaunS) 2 years ago Reply

JaunS, could you try a different lint to connecting the drivers to the CNC shield. The link you provided (below) doesn't want to work.

Thanks, Chuck

"http://www.google.com/aclk?sa=L&ai=CJsz-qXyHVaT4NI-BpgOz94LwAfGztc4F2bbRvMcBgan9z8cCCAkQCSCTsvocKAlgyQbIAQeqBCdP0H5Zn-8nCy2RGxssLtJDpd5Y6at1JbsN_jZke57RBi9VKVjH5ZTABQWgBibYBgKAB9uAjhWIBwGQBwKoB6a-G9gHAeASuJnqi9frloEe&sig=AOD64_2evuLIOGMoGPIUt-AH-xntmPFwwg&adurl=http://rover.ebay.com/rover/1/711-117182-37290-0/2%3Fmtid%3D1588%26kwid%3D1%26crlp%3D53601919689_324272%"

seamster (/member/seamster) 2 years ago Reply

Good info, thank you!

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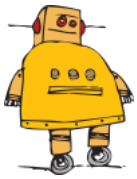

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