

# Programming For Engineers

## Controlling a DC Motor Using Arduino

by

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# Chapter's Information

- Purpose

- The purpose of this writing is to guide students to control DC motor from ARDUINO UNO with the help of L293D motor driver.

- Required materials

We require the following materials in order to perform this project:

- a) ARDUINO UNO board
- b) ARDUINO USB to PC cable
- c) 12V DC motor
- d) L293D motor driver
- e) 12V DC power supply with 2A minimum
- f) Prototype breadboard
- g) Necessary jumper cable



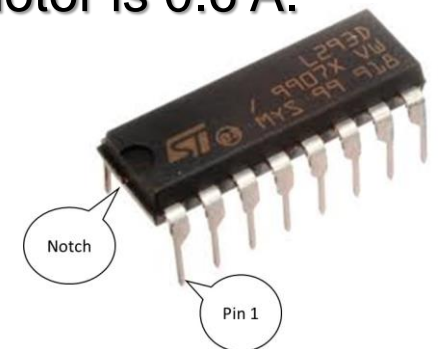
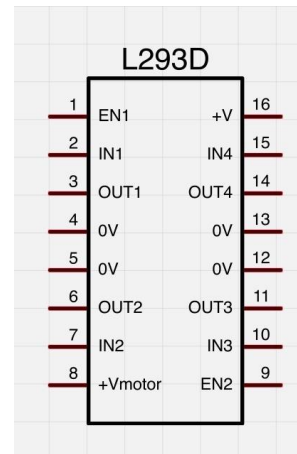
<https://www.iot-store.com.au/products/cytron-dc-geared-motor-with-encoder-spg30e-20k-12vdc-gear-ratio-20-10>



# Project Background

- We are working to make a DC motor rotate. Since a motor can rotate in two directions, we would like to rotate in either direction. We are using L293D motor driver as the IC to cause the motor to rotate. We use ARDUINO to instruct L293D to rotate the motor (1) for the direction of rotation and (2) for how many seconds the motor rotate. Using L293D motor driver, we can manage two motor simultaneously. The maximum current for each motor is 0.6 A.
- On the right are the picture and the pin description of the L293D.

<https://learn.adafruit.com/assets/2482>



[https://upload.wikimedia.org/wikipedia/commons/e/ec/L293D\\_Motor\\_Driver.jpg](https://upload.wikimedia.org/wikipedia/commons/e/ec/L293D_Motor_Driver.jpg)



# Project Background

- In total, L293D has 16 pins. We read the pin numbers relative to the NOTCH. When we read the writing on the IC (from the proper writing position), the NOTCH is on the left side. PIN 1 is at the bottom of the NOTCH while pin 16 is at the TOP of the NOTCH.
- Here are what the pins are for:
  - a. Pin 16 is the supply 5V for L293D logic function. We can supply this 5V from ARDUINO.
  - b. Pin 8 is the power supply for the DC motor power. We shall supply this pin with our 12V power supply.
  - c. We connect Pin 4, Pin 5, Pin 12 and Pin 13 to ground. Make sure that we connect both the ARDUINO ground and the 12V power supply ground to the L293D ground.
  - d. Pin 1 is to ENABLE motor 1. When we supply 5V to Pin 1, we are enabling motor 1. Connecting 0 V (grounding) to Pin 1, disable motor 1.



# Project Background

- e. Pin 9 is to ENABLE motor 2. When we supply 5V to Pin 9, we are enabling motor 2. Connecting 0 V (grounding) to Pin 9, disable motor 2.
- f. We connect Motor 1 to Pin 3 (OUT 1) and Pin 6 (OUT 2). We connect Motor 2 to Pin 11 (OUT 3) and Pin 14 (OUT 4).
- g. We control the direction of motor rotation using the IN1, IN2, IN3 and IN4. For example, if we want to rotate motor 1 in one direction, we supply 5 V to IN1 (Pin 2) and we supply 0 V to IN2 (Pin 7). For reverse direction, we supply IN2 (Pin 7) with 5V and we supply IN2 (Pin2) with 0 V. We use ARDUINO digital pins to supply these IN1 and IN2. Thus, we can programmatically rotate the motor in either direction and for how many seconds. Below is the truth table.



# Project Background

Truth-Table for Motor 1

Pin 1 (EN1)	Pin 2 (IN1)	Pin 7 (IN2)	Motor Action
HIGH	HIGH	LOW	Rotate in one direction
HIGH	LOW	HIGH	Rotate in reverse direction
HIGH	LOW	LOW	No rotation
HIGH	HIGH	HIGH	No rotation
LOW	NA	NA	Motor is disable.

Truth-Table for Motor 2

Pin 9 (EN2)	Pin 10 (IN3)	Pin 15 (IN4)	Motor Action
HIGH	HIGH	LOW	Rotate in one direction
HIGH	LOW	HIGH	Rotate in reverse direction
HIGH	LOW	LOW	No rotation
HIGH	HIGH	HIGH	No rotation
LOW	NA	NA	Motor is disable.



# Project Background

- When we say, 5 V we mean HIGH. The supply voltage may not be 5V. It can be between 3.2 V to 5 V as long as our ARDUINO and L293D are able to communicate! When we say 0 V, we mean LOW. LOW is basically a ground voltage.
  - h. For DC Geared motor, we can observe the cable connection diagram at the back of the gear. We will be connecting to the 1Motor- and 1Motor+ of the motor connection.



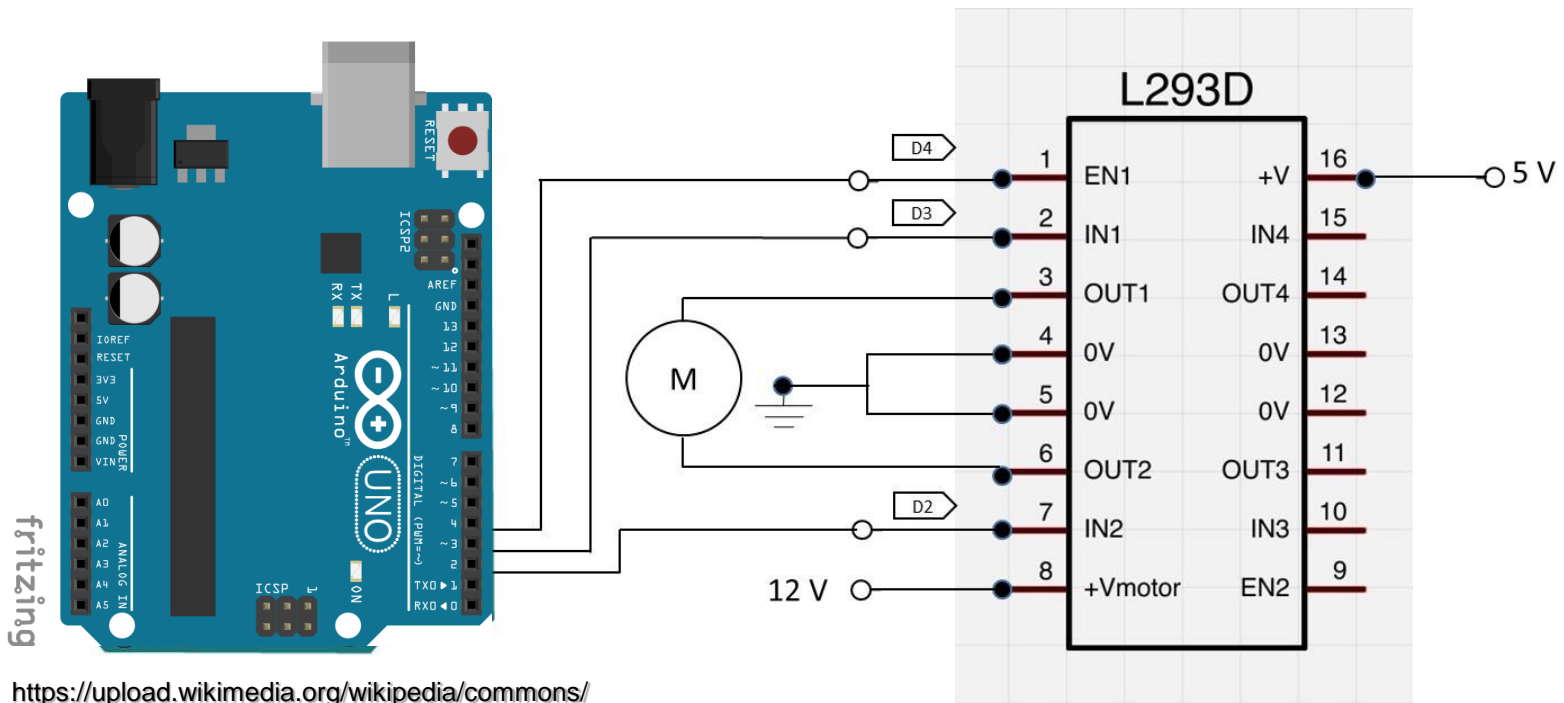
# Step-by-step Actions

- (1) Create Electrical Connection. We will create the connection between ARDUINO and L293D like the figure below. The 12V supply is at Pin 8 can come from the power supply. We supply the 12V from our 12V power supply. For safety reason, try to take 12V from ARDUINO board first. If the motor moving, you can use this 5V. If not you have to take 12V from power supply. You have to take extra careful if using power supply. Make sure all connections are in proper manner. Safety first! The 5V at Pin 16 can come from ARDUINO.





# Step-by-step Actions



[https://upload.wikimedia.org/wikipedia/commons/f/f1/Blik%C3%A1n%C3%AD\\_vestav%C4%9Bno\\_u\\_LED\\_diodou\\_zapojen%C3%AD.png](https://upload.wikimedia.org/wikipedia/commons/f/f1/Blik%C3%A1n%C3%AD_vestav%C4%9Bno_u_LED_diodou_zapojen%C3%AD.png)

<https://learn.adafruit.com/assets/2482>



# Step-by-step Actions

(2) We would like to forward the motor for one second, reverse the motor for one second and stop the motor for one second. Below is our ARDUINO program.

```
int EN1=2; /*Digital Pin2 ARDUINO*/ int IN1=3; /*Digital Pin3 ARDUINO*/
int IN2=4; //Digital Pin4 ARDUINO
void setup() {
    pinMode(EN1,OUTPUT); pinMode(IN1,OUTPUT); pinMode(IN2,OUTPUT); }
void loop() {
    forward_motor(); stop_motor(); reverse_motor(); stop_motor(); }
void stop_motor() { digitalWrite(EN1,LOW); delay(1000); }
void forward_motor() {
    digitalWrite(EN1,HIGH); digitalWrite(IN1,HIGH);
    digitalWrite(IN2,LOW); delay(1000); }
void reverse_motor() {
    digitalWrite(EN1,HIGH); digitalWrite(IN1,LOW);
    digitalWrite(IN2,HIGH); delay(1000); }
```



# Exploration

- Why don't we perform the followings?
  - i. Make the motor rotate in “forward” direction for 2 seconds ONLY after we click a switch.
  - ii. When we click the switch AGAIN, the motor rotate in “reverse” direction for two second.



# Reflections

- We have learn how to:
  - Program and download program using ARDUINO UNO.
  - Use digital pins to read status of a switch.
  - Use digital pins to send out signals.
  - Use L293D motor driver IC.
  - Program the ARDUINO to rotate motor in either direction.
  - Able to control the action timing.

