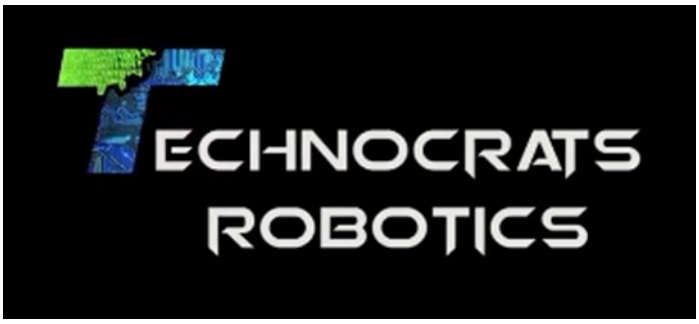

VACATION TASKS

SET-2

Motor Drivers

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Motor Drivers

A motor driver IC is an integrated circuit chip which is usually used to control motors in autonomous robots. Motor driver ICs act as an interface between microprocessors in robots and the motors in the robot. The most commonly used motor driver IC's are from the L293 series such as L293D, L293NE, etc. These ICs are designed to control 2 DC motors simultaneously. L293D consist of two H-bridge. H-bridge is the simplest circuit for controlling a low current rated motor. L293D has 16 pins, they are comprised as follows:
Ground Pins - 4
Input Pins - 4
Output Pins - 4
Enable pins - 2
Voltage Pins – 2

The need for a motor driver circuit

Normal DC gear-head motors requires current greater than 250mA. ICs like 555 timer, ATmega16 Microcontroller, 74 series ICs cannot supply this amount of current. If we directly connect motors to the output of any of the above IC's, they might get damaged.
There is a need of a circuitry that can act as a bridge between the above mentioned ICs and the motors. There are several ways of making it, some of them are mentioned below.

- Using Transistor
- Using L293D/L298
- Using relays

How Motor Driver Operates?

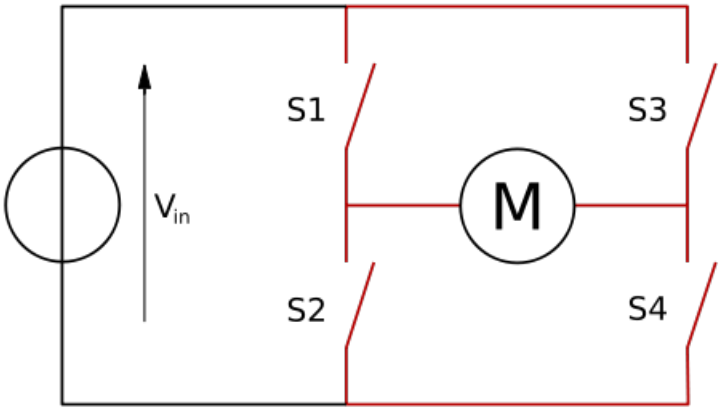
The L293D IC receives signals from the microprocessor and transmits the relative signal to the motors. It has two voltage pins, one of which is used to draw current for the working of the L293D and the other is used to apply voltage to the motors. The L293D switches it output signal according to the input received from the microprocessor.
For Example: If the microprocessor sends a 1(digital high) to the Input Pin of L293D, then the L293D transmits a 1(digital high) to the motor from its Output Pin. An important thing to note is that the L293D simply transmits the signal it receives. It does not change the signal in any case.

L293D And Its Working

The L293D is a 16 pin IC, with eight pins, on each side, dedicated to the controlling of a motor. There are 2 INPUT pins, 2 OUTPUT pins and 1 ENABLE pin for each motor. L293D consist of two H-bridge. H-bridge is the simplest circuit for controlling a low current rated motor.
The Theory for working of a H-bridge is given below.

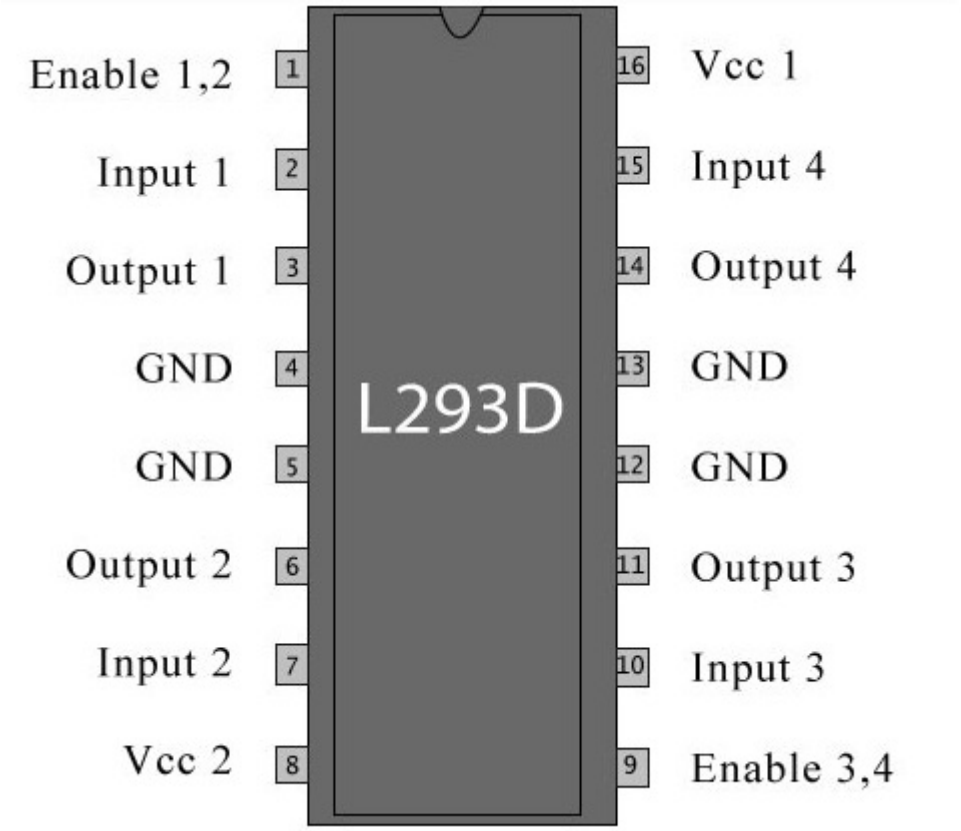
Working Of A H-bridge

H-bridge is given this name because it can be modelled as four switches on the corners of ‘H’. The basic diagram of H-bridge is given below :



In the given diagram, the arrow on the left points to the higher potential side of the input voltage of the circuit. Now if the switches S1 & S4 are kept in a closed position while the switches S2 & S3 are kept in a open position meaning that the circuit gets shorted across the switches S1 & S4. This creates a path for the current to flow, starting from the V input to switch S1 to the motor, then to switch S4 and then the exiting from the circuit. This flow of the current would make the motor turn in one direction. The direction of motion of the motor can be clockwise or anti-clockwise, this is because the rotation of the motor depends upon the connection of the terminals of the motor with the switches.
For simplicity, lets assume that in this condition the motor rotates in a clockwise direction. Now, when S3 and S2 are closed then and S1 and S4 are kept open then the current flows from the other direction and the motor will now definitely rotates in counter-clockwise direction When S1 and S3 are closed and S2 and S4 are open then the ‘STALL’ condition will occur(The motor will break).
Stall Condition:
When the motor is applied positive voltage on both sides then the voltage from both the sides brings the motor shaft to a halt

L293D Pin Diagram :



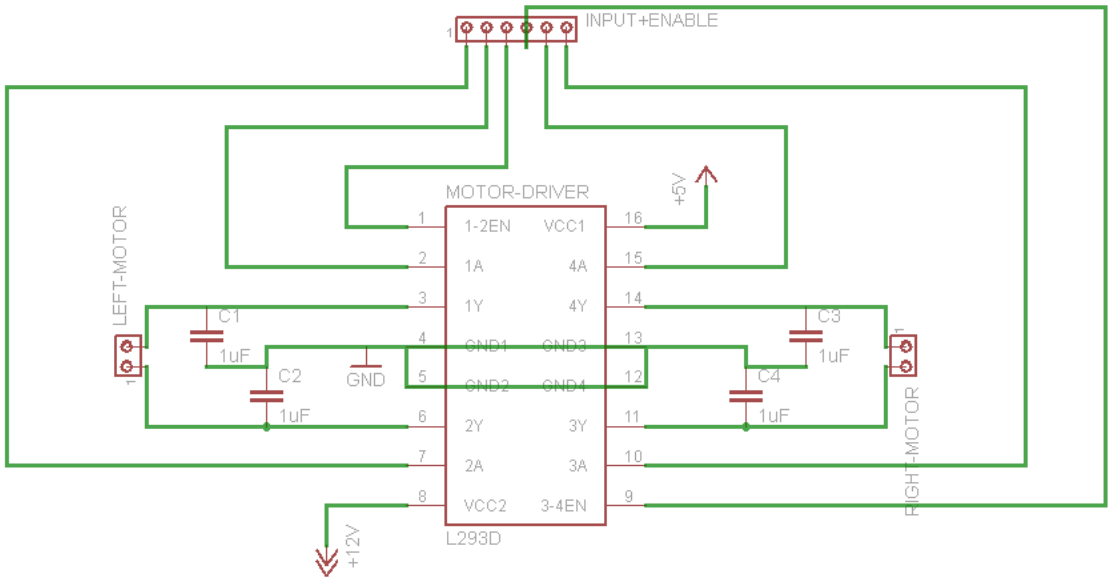
In the above diagram we can see that

Pin No.	Pin Characteristics
1	Enable 1-2, when this is HIGH the left part of the IC will work and when it is low the left part won't work. So, this is the Master Control pin for the left part of IC
2	INPUT 1, when this pin is HIGH the current will flow though output 1
3	OUTPUT 1, this pin should be connected to one of the terminal of motor
4,5	GND, ground pins
6	OUTPUT 2, this pin should be connected to one of the terminal of motor
7	INPUT 2, when this pin is HIGH the current will flow though output 2
8	VC, this is the voltage which will be supplied to the motor. So, if you are driving 12 V DC motors then make sure that this pin is supplied with 12 V
16	VSS, this is the power source to the IC. So, this pin should be supplied with 5 V
15	INPUT 4, when this pin is HIGH the current will flow though output 4
14	OUTPUT 4, this pin should be connected to one of the terminal of motor
13, 12	GND, ground pins

11	OUTPUT 3, this pin should be connected to one of the terminal of motor
10	INPUT 3, when this pin is HIGH the current will flow though output 3
9	Enable 3-4, when this is HIGH the right part of the IC will work and when it is low the right part won't work. So, this is the Master Control pin for the right part of IC

Soldering On A PCB

Given below is the circuit diagram for how the IC needs to be soldered on a PCB with the connectors.



From a six pin relimate INPUT 2, INPUT 1, ENABLE 1-2,ENABLE 3-4,INPUT 3 and INPUT 4 are given.
The inputs to the DC motors are to be given through a two pin relimates whose connectors is shown in the left and right side of the figure.

Working Mechanism

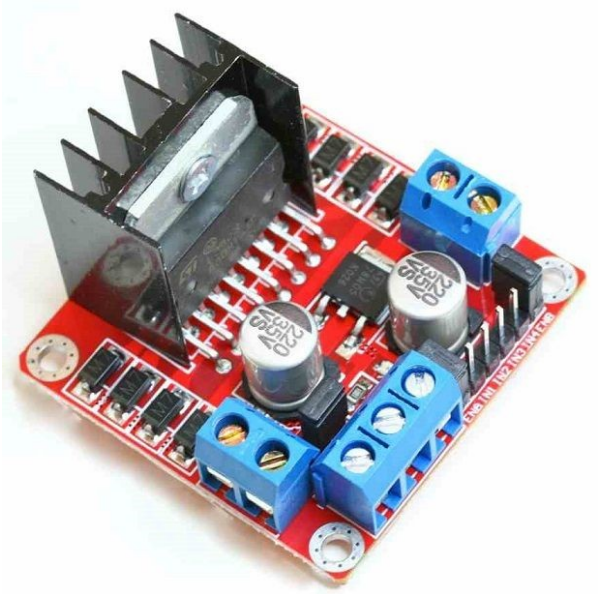
Now depending upon the values of the Input and Enable the motors will rotate in either clockwise or anticlockwise direction with full speed (when Enable is HIGH) or with less speed (when Enable is provided with PWM).
Let us assume for Left Motor when Enable is HIGH and Input 1 and Input 2 are HIGH and LOW respectively then the motor will move in clockwise direction.
So the behaviour of the motor depending on the input conditions will be as follows :

INPUT 1	INPUT 2	ENABLE 1,2	Result
0	0	1	Stop
0	1	1	Anti-clockwise rotation
1	0	1	Clockwise rotation
1	1	1	Stop
0	1	50% duty cycle	Anti-clockwise rotation with half speed
1	0	50% duty cycle	Clockwise rotation with half speed

The motor driver IC deals with heavy currents. Due to so much current flow the IC gets heated. So, we need a heat sink to reduce the heating. Therefore, there are 4 ground pins. When we solder the pins on PCB, we get a huge metalllic area between the grounds where the heat can be released.

The DC motor is an inductive load. So, it develops a back EMF when supplied by a voltage. There can be fluctuations of voltage while using the motor say when suddenly we take a reverse while the motor was moving in some direction. At this point the fluctuation in voltage is quite high and this can damage the IC. Thus, we use four capacitors that help to dampen the extreme variation in current.

Using the L298 Motor Driver Module with Arduino



The Circuit

- Module 5V (or Vcc) - Arduino 5V pin
- Module GND - Arduino GND pin
- Module 12V (or Vbat) - To external power source up to 35V.
- For this tutorial just connect it with Arduino Vin pin.
- Module output 1 & 2 - Connect dc motor A
- Module output 3 & 4 - Connect dc motor B
- Module IN1 - Arduino pin 5
- Module IN2 - Arduino pin 6
- Module IN3 - Arduino pin 10
- Module IN4 - Arduino pin 9

The Code

```
int PWMPin = 10;
int motorSpeed = 0
void setup()

{

}
void loop()

{
for (motorSpeed = 0 ; motorSpeed <= 255; motorSpeed += 10)

{
analogWrite(PWMPin, motorSpeed);
delay(30);
}
for (motorSpeed = 255 ; motorSpeed >= 0; motorSpeed -= 10)
{
analogWrite(PWMPin, motorSpeed);
delay(30);
}

}
```