Expt. 5: Controlling Motors using Arduino boards

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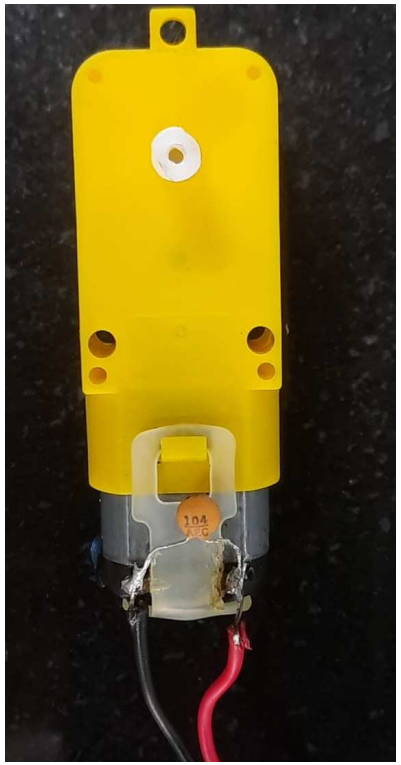
Preparing the Battery Operated Motor

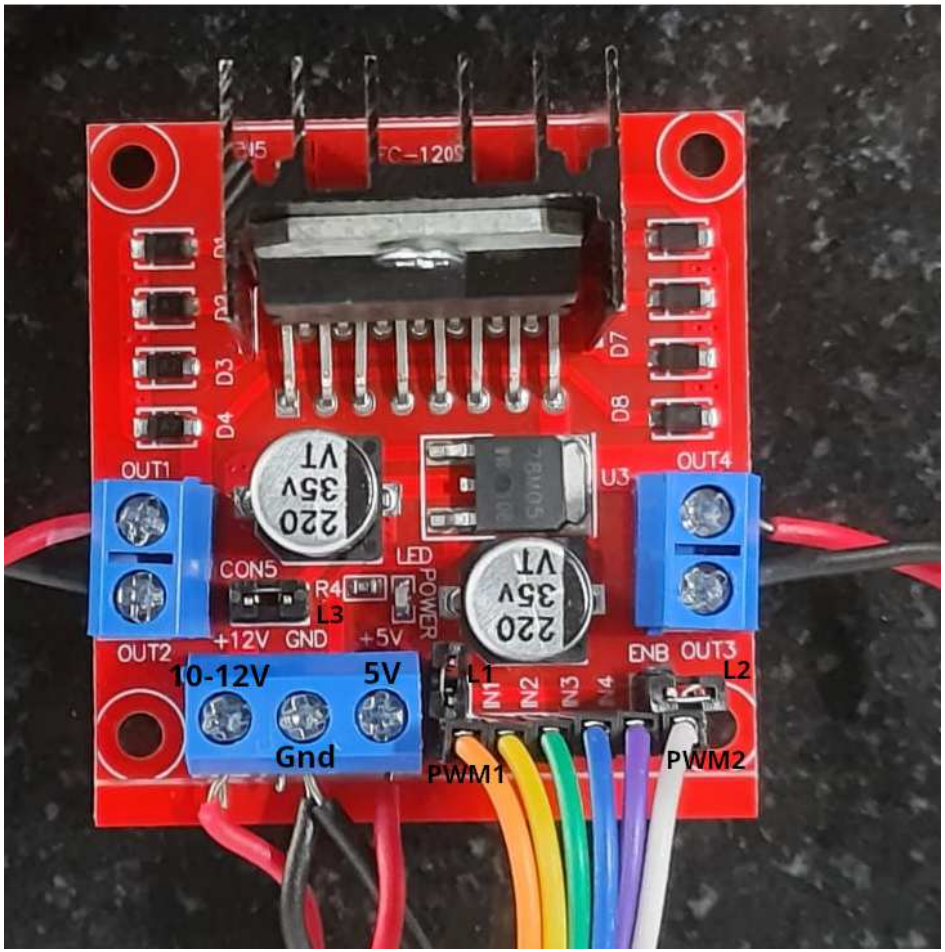
- Before we connect the motor to our circuits, we need to solder a 0.1μF ceramic capacitor across its terminals to suppress noise.
- We also need to solder wires to the motor terminals, so that we can connect it to the motor driver.



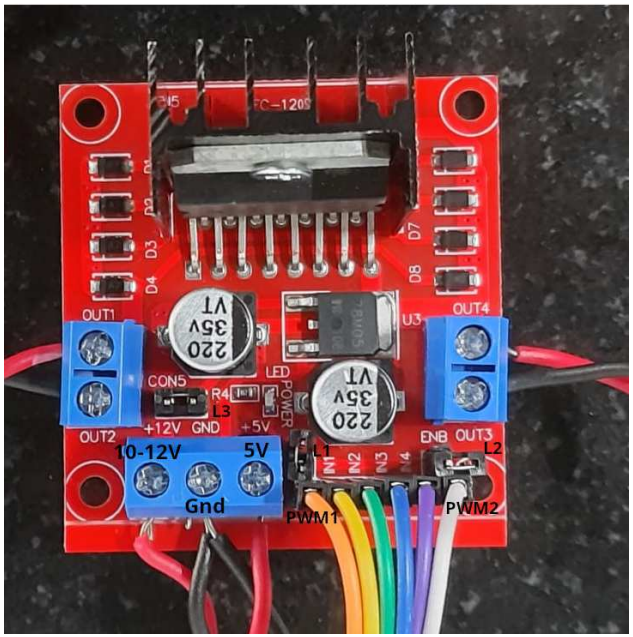
Solder the capacitor and wires to a BO motor.
Seek help from your TA/EE staff if you are unable to solder these neatly.

Connecting Motor and Power to the Driver Board

We shall use the motor driver L298. This board can drive two BO motors, but we are going to use only one motor in this experiment.

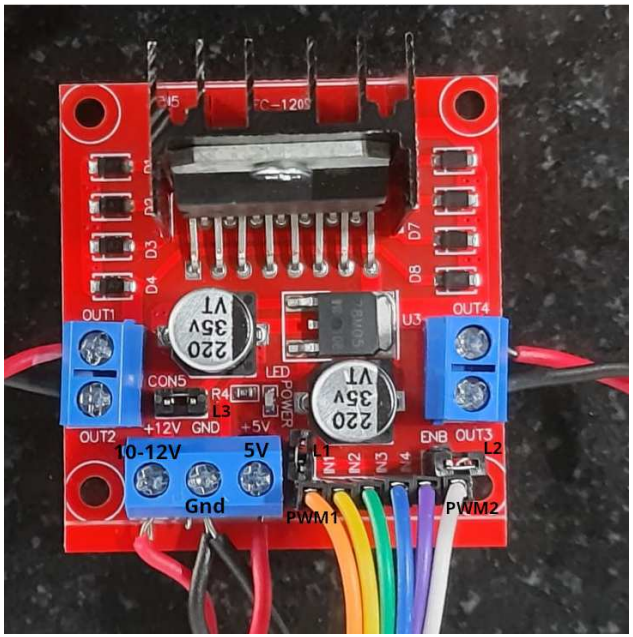


Connecting Motor and Power to the Driver Board



- The motor leads (soldered earlier) should be connected to Motor A terminals (OUT1 and OUT2) on the L298 motor driver board.
- Connect a DC power supply (programmed to 10 V) to the V_S and Ground terminal blocks on the L298 card. The third terminal (meant for 5 V DC) **should be left open**.
- Connect the ground terminal of L298 card to the ground pin of Arduino.

Motor Control Connections



- Remove Link L1. (The link connects the enable input for motor A to 5 V).
- The pin which was connected to 5 V through the link earlier should be connected to pin 10 of Arduino for PWM control.
- Connect the next two pins (IN1 and IN2) on the motor driver to pins 7 and 8 of Arduino.
- It is convenient if female to male hook up wires are used for these connections.

Connection Check List

Links: L3 in; L1, L2 removed.

Power:

Driver card	Power supply
V_S (10-12 V)	Supply+
Ground	Supply−
5 V Terminal	**Open**

Motor card to Arduino

Driver Card	Arduino UNO/nano
Ground	Gnd
Enable A	Pin 10
IN1	Pin 7
IN2	Pin 8

Motor to Driver card

OUT1, OUT2 - Motor wires

After making all the connections, have these checked by your TA.

Rotating the Motor

- Connect your Arduino to the laptop without powering on the motor driver. (Power supply output should be OFF).
- Enter, compile and upload the provided sketch.
- We'll use 10 V power from the power supply (Channel 1 or 2). Set it to 10 V. Program Iset to 1A on this channel and turn ON the output.

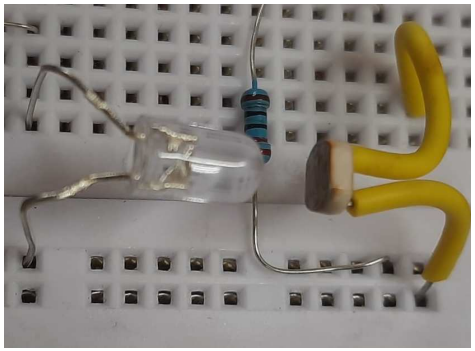
The power LED on motor driver should glow.
If it does not, turn everything off and re-check your connections.

If all is well, your motor should rotate.

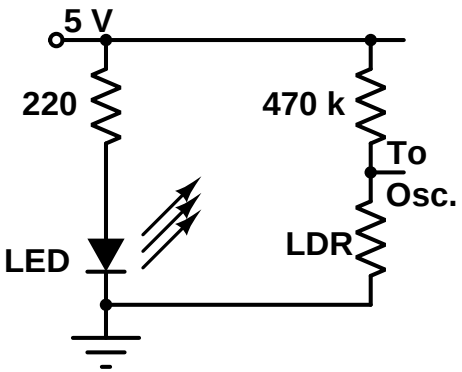
When you have stopped jumping for joy, Call the TA and show your success to him/her. Have your lab book signed that your motor connections are right and the motor is rotating.

Disconnect the power from the motor driver. We have more work to do.

Measuring RPM

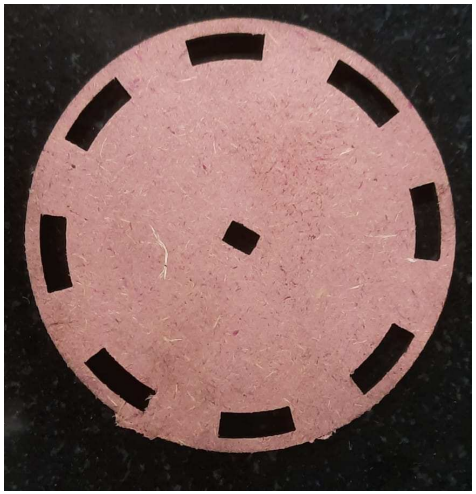


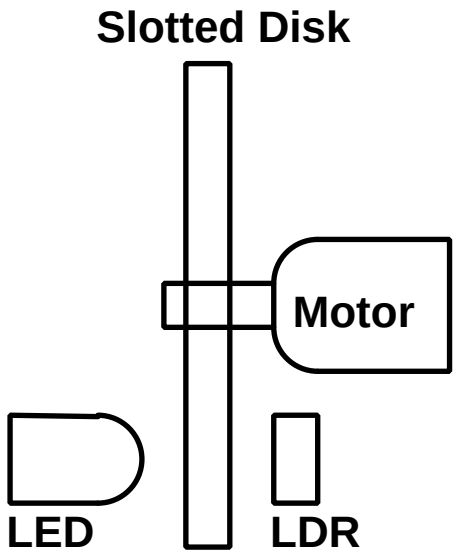
Set up an LED and LDR facing each other (bowing respectfully to each other!) with a gap of about 5 mm on a bread board.



- The LED cathode goes to ground while the anode goes through a 220Ω resistor to +5V of Arduino.
- One end of the LDR goes to ground (also connected to the ground of Arduino) and the other goes to a 470 kΩ resistor. The other end of the resistor will connect to +5V, forming a potential divider as in Expt.4.

Measuring RPM





- Mount the encoder disk with cut out sectors on your motor.
- Power the motor on as before so that the encoder disk rotates.
- Insert the encoder disk between the LED and LDR and view the voltage waveform at the LDR resistor junction on the oscilloscope.

Measuring RPM

- Due to the light beam interruption by rotating sectors on the encoder disk, you will see a square wave on the oscilloscope.
- There may be some noise riding on it due to ambient light being detected by the LDR – this can be ignored.
- Find the time period of the square wave – this is the time taken for one clear and one opaque sector to pass between the LDR and LED.
- Since there are 8 sectors on the disk, multiplying the time period by 8 gives the time taken for one full revolution of the disk.
- From the above, compute the number of revolutions per minute of your motor. This is its RPM at the applied voltage and PWM.

RPM vs PWM Plot

- Modify the PWM value in the given sketch from 32 to 224 in steps of 32.
- Notice that at low PWM values, the motor may not rotate at all. This is normal.
- Compute RPM for each value of PWM. Enter these values in your note book as a table and have these signed by your TA.
- Plot RPM vs the applied PWM.

After this, enter, compile and upload the second sketch given to you. See the motor accelerate in one direction, decelerate, then accelerate in the other direction and decelerate to idle condition.

Arduino-Motor Driver without Laptop Connection

Your final project will require your system to operate without a Laptop connection. So the last part of this experiment will configure the system so that Arduino board is powered by the driver card and not by USB.

- Turn OFF the output of 10 V supply.
- **Remove the USB connection from Arduino.**
- Connect a wire from the 10-12 V input terminal of the driver card to V_{in} of Arduino.
- Now turn on the 10 V supply.

Your motor should operate as before, accelerating, decelerating and changing direction.

Sometimes the motor injects too much noise into the 10-12 V supply, which may get into the Arduino card and cause problems.
If this happens and adding a 0.1μF capacitor between V_{in} and Ground does not solve the problem, you can connect the 5V output from the driver to 5 V pin on Arduino. (This is a less preferred configuration).

Arduino-Motor Driver without Laptop Connection

Show the motor being driven by your board without a USB connection to your TA/RA and have your lab note book signed stating this.

As a final step, you can replace the power supply by a 3 cell rechargeable Li battery and see that the board/driver/motor combination works without connecting to any mains operated equipment.

Now you have enough background about Arduino boards to work on your project.

Have fun designing your robot for the project!