

## EXAMPLE 02

### INTRODUCTION

Arduino varies speed of DC Motor using PWM and measures its RPM using optical sensor and displays them on LCD

In DC motor speed testing, the PWM is applied to motor and its duty cycle is varied from min to max. While applying PWM the actual RPM of DC motor is also measured and note down to see how motor speed (RPM) varies as PWM width varies. Along with this, the applied voltage to motor is also measured to see the motor speed at different applied voltage. Finally, after noting down all the values, the observation table is prepared for pulse width (duty cycle), applied voltage and motor speed in RPM. This table is used to prepare duty cycle->RPM graph or applied voltage->RPM graph of motor.

The given project demonstrates above example. It applies PWM to DC motor to vary its speed from min to max and max to min continuously and also measures following parameters:

- 1) PWM width in %
- 2) Applied voltage to motor
- 3) Motor speed in RPM

It uses arduino UNO board to generate PWM and measure/calculate above 3 parameters. These parameters are displayed on 16x4 LCD. It is very easy to vary speed of DC motor using arduino. Arduino can generate PWM on its analog output pin and when it is applied to DC motor, its speed varies. So it is very simple and easy task. To measure RPM, opto-interrupt sensor MOC7811 is used. When motor completes 1 revolution, the sensor generates 1 pulse and such pulses are calculated by arduino to calculate RPM. So let us see how this is done. Lets start with circuit diagram first, followed by its descriptions and operation.

### THINGS USED IN THIS PROJECT

Hardware components		
	<a href="#">Arduino UNO</a>	1
	Geared DC Motor, 12 V	1
	Alphanumeric LCD, 20 x 4	1
	Darlington High Power Transistor	1
Software apps and online services		

	<a href="#">Arduino IDE</a>	
<b>Hand tools and fabrication machines</b>		
	Breadboard, 270 Pin	

## BUILD THE CIRCUIT

As shown in figure, the circuit is built using arduino UNO development board, 16x4 LCD, NPN Darlington transistor TIP122 and opto interrupt sensor MOC7811.

- The analog output pin 9 of arduino drives 12V@2000 RPM DC motor through TIP122. This pin is given to base input of TIP122 through current limiting resistor R2 and DC motor is connected to collector of TIP122
- The internal IR LED of MOC7811 is given forward bias using 5V supply form arduino board through current limiting resistor R1. Internal photo transistor is pulled up by resistor R4. The collector output of transistor is connected to digital pin 7 or arduino
- LCD data pins D4 to D7 are connected to digital pins 5, 4, 3 and 2 of arduino while control pins Rs and En are connected to 12 and 11. RW pin is connected to ground. Vcc pin and LED+ pin are connected to 5V supply from arduino board and Vss pin and LED- pins are connected to arduino board ground
- One pot is connected to Vee pin to vary kontras of LCD

### Circuit operation:

## SCHEMATICS

The shematics of circuit of DC Motor speed control and measurement using Arduino and LCD is shown in the Fig. 1 below. That figure shows all the components described before and its connections together.

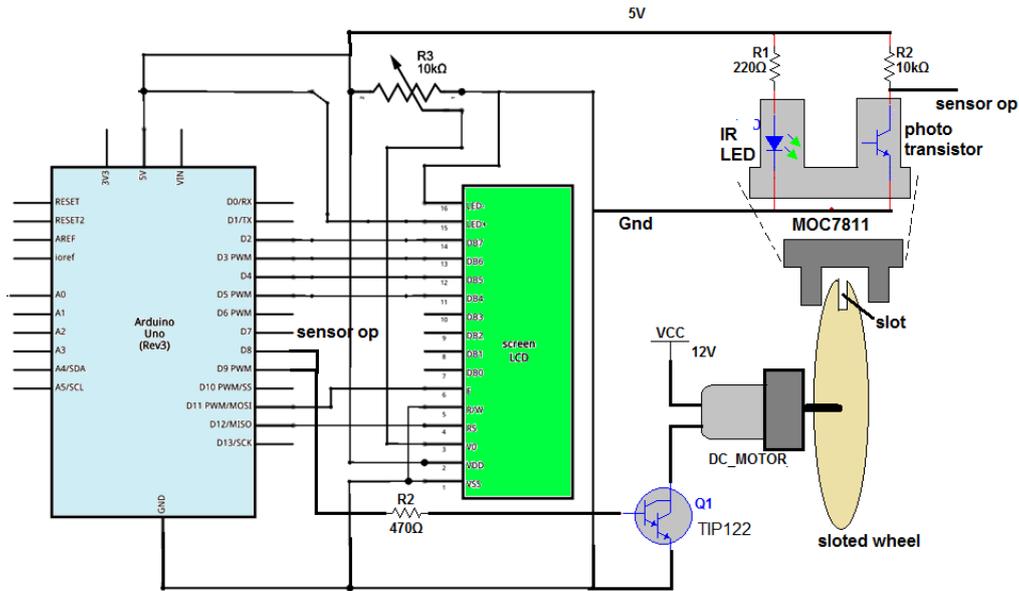


Fig. 1 Schematics of circuit

## CODE

C/C++

DC Motor speed control and measurement using Arduino and LCD

```
#include <LiquidCrystal.h>
```

```
LiquidCrystal lcd(8, 9, 10, 11, 12, 13);
```

```
#define motor_RPS_pulse_ip 7
```

```
#define motor_PWM_pulse_ip 4
```

```
int motor_RPS_Ton,motor_RPS_Toff,PWM_Ton,PWM_Toff,PWM_T;
```

```
int PWM_duty,pulse_width=255,RPS,motor_RPS_period,RPM;
```

```
float voltage;
```

```
void setup()
```

```
{
```

```
  pinMode(motor_RPS_pulse_ip,INPUT);
```

```
  pinMode(motor_PWM_pulse_ip,INPUT);
```

```
  lcd.begin(16, 4);
```

```
  lcd.clear();
```

```
  lcd.print("Pulse Width:");
```

```
  lcd.setCursor(0,1);
```

```
  lcd.print("PWM Volt:");
```

```
  lcd.setCursor(0,2);
```

```
  lcd.print("Speed(RPS):");
```

```
  lcd.setCursor(0,3);
```

```
  lcd.print("Speed(RPM):");
```

```
}
```

```
void loop()
```

```
{
```

```
  analogWrite(3,pulse_width);
```

```
  PWM_Ton= pulseIn(motor_PWM_pulse_ip,HIGH);
```

```

PWM_Toff=pulseIn(motor_PWM_pulse_ip,LOW);
delay(2000);
PWM_T = PWM_Ton+PWM_Toff;
PWM_duty = (PWM_Ton/PWM_T)*100;
voltage = 0.12*PWM_duty;
lcd.setCursor(12,0);
lcd.print(PWM_duty);
lcd.print('%');
lcd.setCursor(9,1);
lcd.print(voltage);
lcd.print('V');
pulse_width-=15;
if(pulse_width==90) pulse_width = 255;
delay(3000);
}

```

## BREADBOARD VIEW OF THE READY MADE CIRCUIT

So called breadboard view of its circuit can be seen at the Fig. 2 below

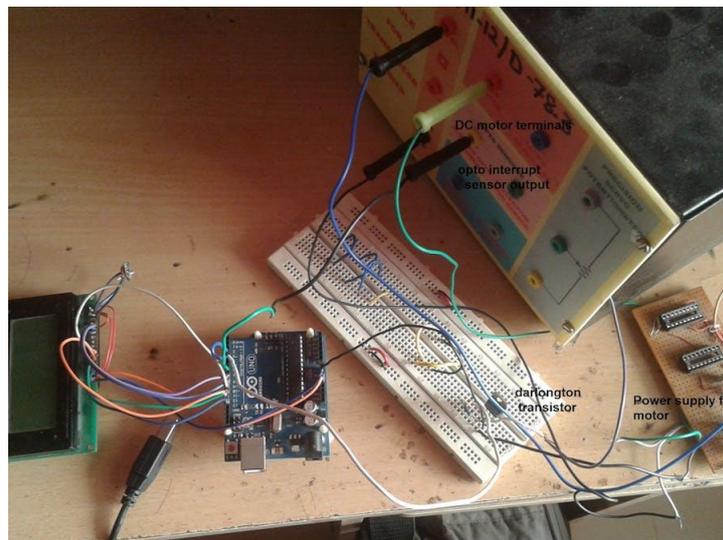


Fig. 2 Breadboard view of the circuit with the specification of main components