



ISSN: 2350-0328

**International Journal of Advanced Research in Science,
Engineering and Technology**

Vol. 5, Issue 8 , August 2018

Speed Control of a DC Motor Using Pulse Width Modulation, Potentiometer and IR Sensor

ShubhamBanerjee, SandiptaMondal, BhaskarSaha, ArnabJyotiMandal

Department of Electrical and Electronics engineering, University of Engineering and Management, Kolkata
Department of Electrical and Electronics engineering, University of Engineering and Management, Kolkata
Department of Electrical Engineering, University of Engineering and Management, Kolkata
Department of Electrical Engineering, University of Engineering and Management, Kolkata

ABSTRACT: Now days in industry, DC motor is widely used for its easy speed control and load characteristics as it is effective and provides precise output, which results in the application of DC motor in large scale for commercial purposes. Speed control of DC motor is very crucial in applications where large variation of speed is required. In our research, an initiative has been adopted to control the speed of DC motor using Pulse Width Modulation (PWM) method by embedding a control system into a DC motor using Arduino UNO R3, L298n Motor Driver, 100k Potentiometer and an IR Sensor (to measure the speed of the motor), to fulfill the requirements for controlling and measuring the speed of a DC motor

KEYWORDS: DC motor, PWM, Potentiometer, IR Sensor, Arduino UNO

1. INTRODUCTION

Speed control of a DC motor can be achieved by using mechanical or electrical techniques. In past, speed control of DC drives was mostly mechanical and required large size hardware to implement. The development has launched these drives back to position of formidable relevance which give rise to A.C drives. Some important applications are rolling mills, paper mills, traction, printing, textiles mills etc. Fractional horse power D.C drives are widely employed [1]. Due to the ability to supply continuously variable D.C voltage, controlled rectifier and DC chopper made a revolution in modern industrial equipment and variable drives [2]. Adjustable speed drives may be operated over a wide range of, by controlling armature or field excitation [3].

The speed control of a DC motor is crucial in applications where precision and protection are essential. The purpose of a motor speed controller is to take a signal representing the required speed and to drive a motor at that speed. Microcontroller's can provide easy control of a DC motor. A microcontroller based speed control system consists of an electronic component and a microcontroller. There are many applications of DC motor drives that use power electronics to control the voltage and consequently the speed or position of the motor. For large motors it is highly economical to use power electronics, in order to minimize the powerloss and the size of the motor. DC choppers are easily implemented[4]. In this paper, an Arduino UNO system (microcontroller) was used for the control signal. The DC motor is driven by a high frequency PWM signal using an Arduino UNO microcontroller. Controlling the PWM duty cycle is equivalent to controlling the motor terminal voltage, which in turn directly adjusts the motor speed. This work is a practical one and highly feasible from an economic and accuracy point of view[4]. Pulse Width Modulation, or PWM, is a technique for getting analog results with digital means. Digital control is used to create a square wave, a signal switched between on and off. This on-off pattern can simulate voltages in between full on (5Volts) and off (0 Volts) by changing the portion of the time the signal spends on versus the time that the signal spends off. The duration of "on time" is called the pulse width. To get varying analog values, you change, or modulate, that pulse width. Here we are using this process to control the speed of a small dc motor. PWM is a technique by using which, we can control the voltage or power. To understand more simply, if we are apply 5 volt for driving a motor then motor will move with



some speed, now if we reduce the applied voltage by 2, i.e. we apply 3 volt to the motor then the speed of the motor also decreases[5].

The desired objective is to achieve a system running on a desired constant speed at any load condition. That means the motor will run on a fixed speed instead of varying with the amount of load

II.RELATED WORK

A reasonable number of works have found in the literature regarding the control of DC motor using different devices. Vikhe, Punjabi, and Kadu (2014) reported how DC motor can be controlled by using a PID controller in LabVIEW. The speed of the DC motor is set by creating a Graphic User Interface (GUI) for PID Controller in LabVIEW. LabVIEW in turn pass this speed to the DC motor using a PWM pins on the Arduino Uno board. DC motor move with the speed set by the user in LabVIEW. The speed of the DC motor is sensed by using the tachometer. From tachometer, the output is sent back to the PID Controller in LabVIEW via Arduino board. PID Controller compares the actual speed of the DC motor with the set speed. If its speed is not same, PID Controller will try to minimize the error and bring the motor to the set point value. Swain et al (2017) designed to develop a four-quadrant speed-control system for a DC motor which is operated in four quadrants: clockwise, counter clock-wise, forward brake and reverse brake. Instantaneous brake in both the directions happens as a result of applying a reverse voltage across the running motor for a brief period and the speed control of the motor can be achieved with PWM pulses generated by the Arduino Board. Choubey et al (2018) reported that implementation of the MC68HC11E9 microcontroller for speed control of DC motor fed by a DC chopper has been investigated. The chopper is driven by a high frequency PWM signal. Controlling the PWM duty cycle is equivalent to controlling the motor terminal voltage, which in turn adjusts directly the motor speed. Mallick et al (2017) , used ATMEGA328 Microcontroller, 9v battery, 12v dc motor, one npn transistor, one diode, one micro farad capacitor, 1kilo ohm resistor and one pressure button to control the speed of the DC motor. The control signals are transferred from Arduino UNO microcontroller to pressure button. Javed et al (2017) elucidated the speed control of DC motor with Chopper based speed control system consisting of electronic components which include IC 555 timer is for generating PWM, IGBT switch based chopper, 4007 diode, electrolytic and 104 capacitor is used in 12 volt rectifier, opto-coupler is used for electrical isolation .

II. MATERIALS AND METHODS

To design and implement Speed Control of a DC Motor, following electronic devices were used and connected as per the circuit diagram provided in figure 1.

Electronic devices	Number
Arduino UNO R3	1
L298N Dual H-Bridge Motor Driver	1
16 x 2 LCD display	1
IR Sensor	1
DC Motor	1
100K POT	1

In this project we have kept the space to modify the speed control of DC Motor both manually and logically by using potentiometer and L298N H-Bridge respectively. First we change the speed manually, measure it with the help of an IR sensor and the measured value will be displayed on a 16*2 bit LCD module. After this we change the speed logically by changing the value of ENA in program and repeat the same.

ARDUINO can be programmed with ARDUINO software(ide). LiquidCrystal.h header file is added to library for the functioning of the 16*2 LCD module. The ATMEGA 328 on the ARDUINO UNO can be preprogrammed with a boot



ISSN: 2350-0328

International Journal of Advanced Research in Science, Engineering and Technology

Vol. 5, Issue 8 , August 2018

loader that allows to upload new code to it without the use of an external hardware programmer. The software serial library allows serial communication on any digital pins. The atmega328 also support 12c.

III. PROGRAM AND CODE

```
#include <LiquidCrystal.h>
LiquidCrystallcd(8,9,4,5,6,7); //defining lcd pins
constintdataIN = 2; //IR sensor INPUT
unsigned long prevmillis; // To store time
unsigned long duration; // To store time difference
unsigned long lcdrefresh; // To store time for LCD to refresh
int rpm; // RPM value
booleancurrentstate; // Current state of IR input scan
booleanprevstate; // State of IR sensor in previous scan
// MOTOR A
int ENA = 10;
int IN1 = 12;
int IN2 = 13;
void setup()
{
  // put your setup code here, to run once:
  pinMode(dataIN,INPUT);
  lcd.begin(16,2);
  prevmillis = 0;
  prevstate = LOW;
  pinMode (ENA, OUTPUT);
  pinMode (IN1, OUTPUT);
  pinMode (IN2, OUTPUT);
}
void motor()
{
  // Turn on MOTOR A
  digitalWrite(IN1, HIGH);
  digitalWrite(IN2, LOW);
  // Set Speed from 0-255
  analogWrite(ENA, 90);
}
void loop()
{
  // RPM Measurement
  currentstate = digitalRead(dataIN); // Read IR sensor state
  if(prevstate != currentstate) // If there is change in input
  {
    if(currentstate == HIGH ) // If input only changes from LOW to HIGH
    {
      duration = ( micros() - prevmillis ); // Time difference between revolution in microsecond
      rpm = (60000000/duration); // rpm = (1/ time millis)*1000*1000*60;
      prevmillis = micros(); // store time for next revolution calculation
    }
    }prevstate = currentstate; // store this scan (prev scan) data for next scan
  // LCD Display
  if ( ( millis()-lcdrefresh ) >= 100 )
  {
    lcd.clear();
    lcd.setCursor(0,0);
```



ISSN: 2350-0328

International Journal of Advanced Research in Science, Engineering and Technology

Vol. 5, Issue 8 , August 2018

```
lcd.print("Speed of Motor");  
lcd.setCursor(0,1);  
lcd.print("RPM = ");  
lcd.print(rpm);  
lcd.refresh = millis();  
}motor ();  
}
```

In the figure 2 below, the green lines represent a regular time period. This duration or period is the inverse of the PWM frequency. In other words, with Arduino's PWM frequency at about 500Hz, the green lines would measure 2 milliseconds each. A call to analog Write () is on scale of 0 -255, such that analogWrite(255) requests a 100% duty cycle(always on), and analogWrite(127) is a 50% duty cycle (on half the time).

IV. RESULTS

Arduino Uno R3 is used to generate PWM, L298N motor driver is used to drive the DC motor and 100k POT is used to control the DC motor manually, and an IR Sensor is used to measure the speed of that motor.

V. DISCUSSION

Speed control of a DC motor employs the use of different technologies in its design, development, and implementation. This system used an Arduino UNO R3, IR Sensor, Potentiometer and a Motor Driver to control the speed of a DC motor and measure it accordingly. This research has successfully provided an improvement on existing speed control of DC motor techniques using PWM by its use of calibrated circuit so that the motor can be controlled both logically and manually and has also made a point that an IR sensor can be modified into a Tachometer. For successful completion such project implementation some precautions should be taken like -All the connections should be properly made, proper insulations should be used around connections to avoid short circuit.

VI. ACKNOWLEDGEMENT

The authors are thankful to Dean University of Engineering and Management (UEM), Kolkata for approving and providing opportunity to participate in this project. The authors are also thankful to the Head of the Departments of Electrical Engineering and Electrical and Electronics Engineering for their fruitful suggestions in completing the research project.

REFERENCES

- [1] Gopal K. Dubey, "fundamentals of Electric Drives", Narosa publishing House New Delhi, 1989
- [2] Muhammad Rasid, "Power Electronics circuits, Devices and Applications" Prentice Hall, 3rd edition.
- [3] Atul Dewangan, Nibbedita, Sashi, Vinod Yadu, "PWM Based Automatic closed loop speed Of DC motor", international journal of engineering trends and technology- volume 3 issue2-2012.
- [4] Syllignakis J., Panagiotakopoulos P., Karapidakis E "Automatic Speed Controller of a DC Motor Using Arduino, for Laboratory Applications" Engineering and Industry Series Volume Power Systems, Energy Markets and Renewable Energy Sources in South-Eastern Europe, Trivent Publishing, 2016
- [5] <https://circuitdigest.com/microcontroller-projects/dc-motor-speed-control-using-arduino-and-potentiometer>
- [6] Atul Kumar Dewangan, Nibbedita Chakraborty, Sashi Shukla, Vinod Yadu. "PWM Based Automatic Closed Loop Speed Control of DC Motor". International Journal of Engineering Trends and Technology (IJETT). V3(2):110-112 Mar-Apr 2012.
- [7] Pratap Vikhe, Neelam Punjabi, Chandrakant Kadu "Real Time DC Motor Speed Control using PID Controller in Labview" International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering, volume 3, issue 9, page 12162-12167
- [8] Saman Javed, Sumit Jha, Hasan Sajid, Vishu Kumar "Speed Control Of Separately Excited Dc Motor Using Chopper" International Journal Of Scientific Research And Management Studies Volume 3 Issue 1, Page: 80-87, 2016
- [9] Santosh Kumar Mallick, Avinash Singh, Ajay Kumar Singh and Hare Ram Kumar "Speed Control of DC Motor Using Arduino" International Journal of Interdisciplinary Research, Vol-3, Issue-4, 2017, page 1160-1162
- [10] Ritesh Chaubey, Deepak Kumar and Saketh, Dr. Sudeshna "Speed and Direction Control of DC Motor using Android Mobile Application, International Journal of Electrical Electronics & Computer Science Engineering, Special Issue - ICSCAAIT-2018, page 101-102

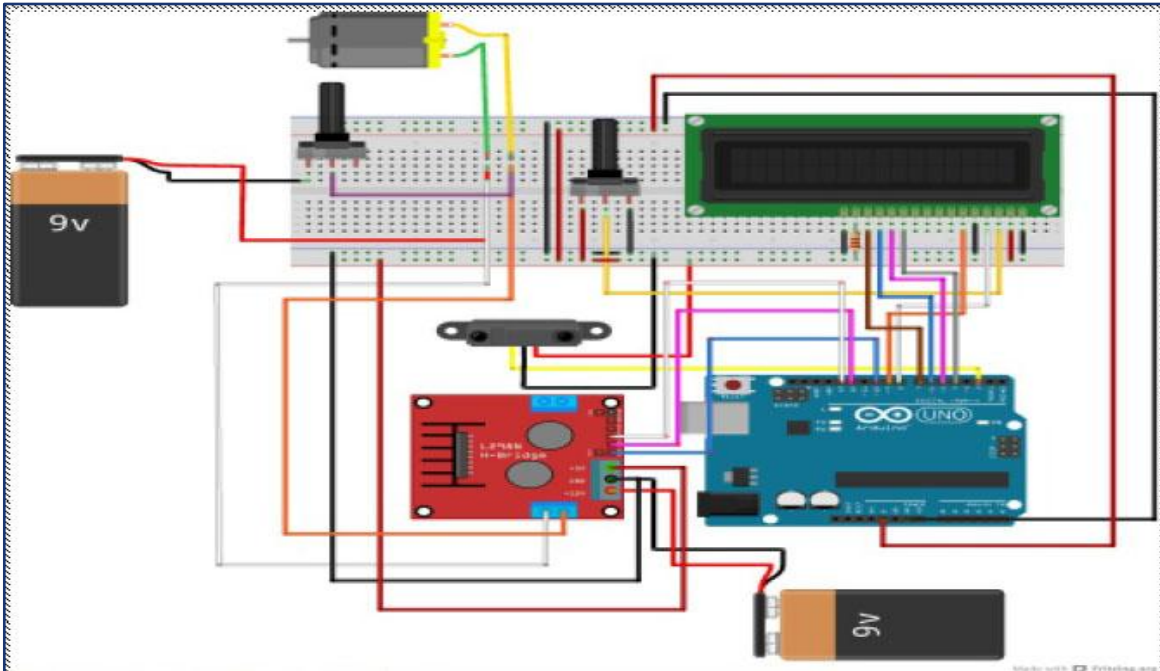


Figure-1: Circuit diagram

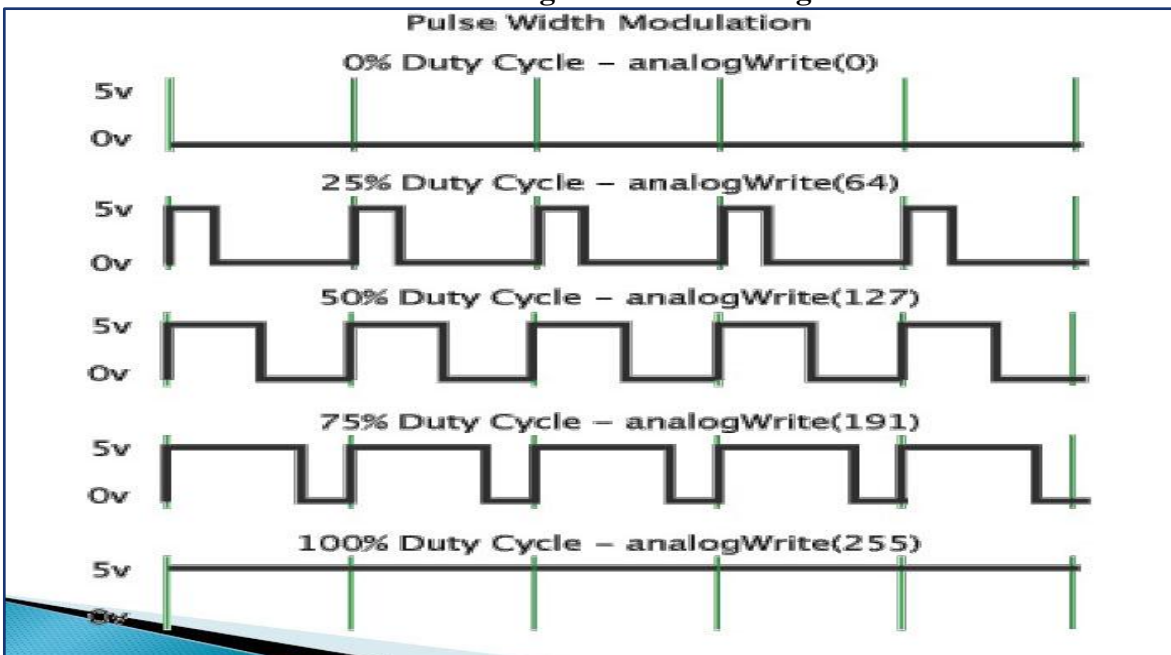


Figure 2: Graphic Representation