# DC MOTOR WITH PWM SPEED CONTROL IN ALL FOUR QUADRANTS USING MICROCONTROLLER

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## ABSTRACT

In this paper, a four-quadrant speed system for DC motors has been designed, constructed, and tested. the foremost advantage of employing a DC motor is that the Speed-Torque relationship is varied to almost any useful form. to appreciate the speed control, an electronic technique called Pulse Width Modulation is employed which generates High and Low pulses. These pulses vary the speed within the motor. For the generation of those pulses, a microcontroller is employed. As a microcontroller is employed setting the speed ranges as per the need is straightforward which is completed by changing the duty cycles period of its slow within the program. Different speed grades and directions rely upon different buttons. Experiments have proved that this method is of upper performance.

**Key words-**Dc motor, PWM, Microcontroller 8051, motor driver IC L293D

## Introduction

The project is meant to develop a four-quadrant-speed-control system for a DC motor with PWM. The motor is operated in four quadrants i.e., clockwise; clockwise clock-wise, forward brake, and reverse brake. Four-quadrant operation of a DC motor is best suited to industries whereby the motor's unit of measurement is employed as per the requirement. they go to rotate in central, counter-clockwise directions. Also, one can apply brakes for an on-the-spot stop in every direction. inside the case of a selected operation within the Associate in Nursing industrial atmosphere, a motor should be stopped currently. This planned system is extremely useful in such a scenario, as forwarding and reverse brake space units are its integral choices. The break-all told directions are feasible thanks to the appliance of a reverse voltage to the running DC motor for a quick quantity. The motor's speed management is additionally achieved with the PWM pulses generated by the microcontroller. The microcontroller used during this project is from the 8051 families. Few push-buttons interfaced to the microcontroller unit of measurement provided for the operation of the motor therefore the sign to the motor and

successively, management of the speed of the motor through the motor driver IC. The speed management feature by the push-button operation is additionally on the market throughout this project. This project could even be augmented by the pattern of high-octane electronic devices to manage high-capacity DC motors. Regenerative braking for optimizing power consumption may additionally be incorporated.

## METHODOLOGY

The traditional method of controlling speed was that the resistance is strung within the rotor circuit or adjust the voltage of the electrical machinery circuit, the 2 methods are easy, but they exist some shortcomings: the graceful character is bad and therefore the characteristic is soft in low speed, The motor speed is going to be changed larger when the load is changed; The motor speed is extremely hard to urge low when the load is light; The larger the resistance ais the greater its losses are, the Efficiency reduces noticeably. Therefore, a replacement quiet speed control method is named PWM (pulse width modulation) speed the regulating system has been widely utilized in the control speed. With the wide use of PWM technology, the facility energy can fill used, and also the circuit efficiency is extremely high.

## System Overview

The format was modified from broken right down to different modules to simplify the circuit format. Figure1 describes the overall device format for the four-quadrant pace manipulation of the dc motor. Figure1.Block diagram of the device.
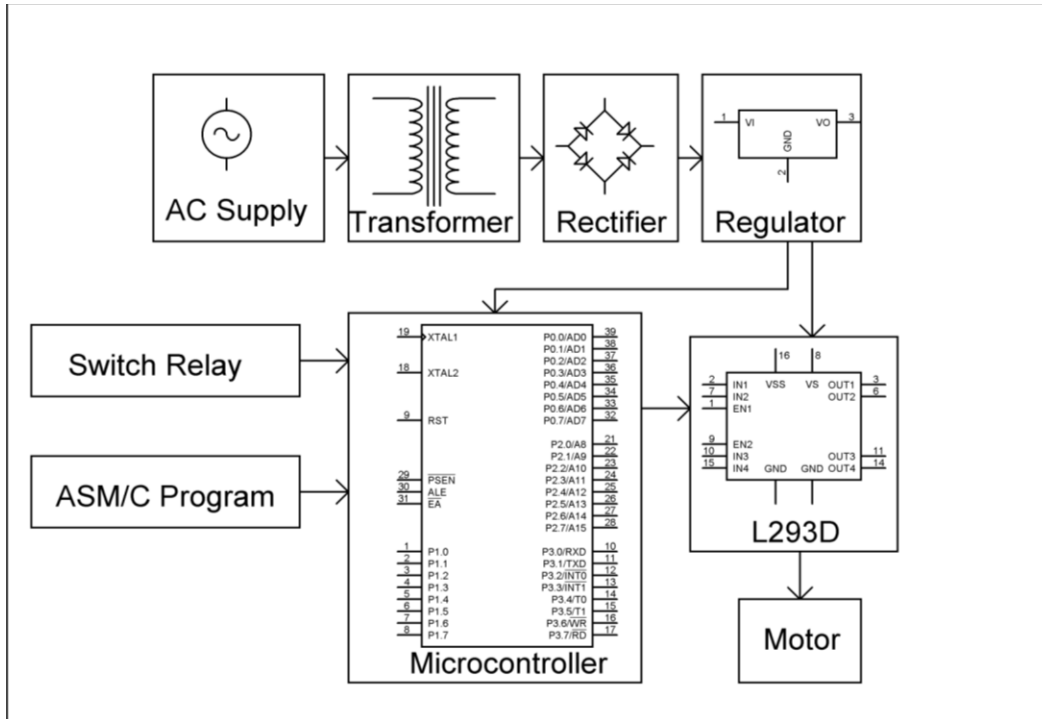
## BLOCK DIAGRAM



Figure1. Block diagram of the system

The above figure shows the block diagram of the whole system. the first is we due to power supply to the transformer which converts 230v single phase supply into 12v single-phase supply this the step-down transformer. the next is the rectifier the 4 diodes form a bridge rectifier that gives you pulsating dc which is unregulated are regulated to a steady 5V dc. next is the regulator. The voltage regulator has maintained the constant output voltage. regulator through supply is given to motor drive IC which takes the low-current signal from the controller circuit and amps it up into a high-current signal. motor drive IC through the dc motor. regulator through microcontroller 8051 which is the brain of the circuit.

## The function of each part

1) **Transformer:**

   The transformer is a static device that converts one ac circuit to another ac circuit with changing current and voltage but without changing power and frequency. The circuit makes use of a trendy energy supply comprising a step-down transformer from 230V to 12V.

2) **bridge rectifier:**

   The bridge rectifier is used to AC (alternating current) to DC (direct current). the 4 diodes forming a bridge rectifier that gives you pulsating dc which is unregulated are regulated to a stable 5V dc.

3) **Pulse-width modulation (PWM):**

   Pulse-width modulation (PWM) is a commonly used method for controlling the electricity of an electrical device, made practical through the way of current virtual electricity switches. The not unusual place fee of voltage (and current) fed to the burden is managed through manner of way of turning the switch amongst handing over and load on and rancid at a brief pace. The longer the switch is on in evaluation to the off periods, the higher the electricity supplied to the burden is. The term duty cycle describes the proportion of on-time to the everyday interval or period a low duty cycle corresponds to low electricity because of the truth the electricity is of a most of the time. The duty cycle is expressed in percent, with 100% in reality. the precept advantage of PWM is that electricity loss withinside the switching devices can be very low. When a switch is off there is nearly no current, and at the same time, as it is on, there is almost no voltage drop at some point of the switch. Power loss, being made of voltage and current, is for that reason in every example close to zero. PWM works moreover well with digital controls, which, because of the truth in their one-off nature, can without trouble set the wanted duty cycle. PWM has moreover been applied in sure conversation systems wherein its duty cycle has been used to supply data over a communications channel. The duty cycle determines the rate of the motor. The preferred speed can be obtained through manner of way of changing the duty cycle. The PWM withinside the microcontroller is used to control the duty cycle of the DC motor.

4) **Motor driver IC:**

   A motor driver takes the low-current signal from the controller circuit and amps it up into a high-current signal, to properly drive the motor.L293D IC could be a typical Motor Driver IC that permits the DC motor to drive in any direction. It controls a high-current signal using a low-current signal.
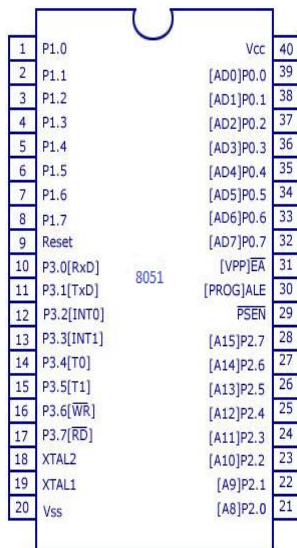
5) **DC motor:**

   A DC motor run on a direct current. this motor is used for the lode in the project in an electric motor, the operation is based on simple faraday's law of electromagnetic induction.
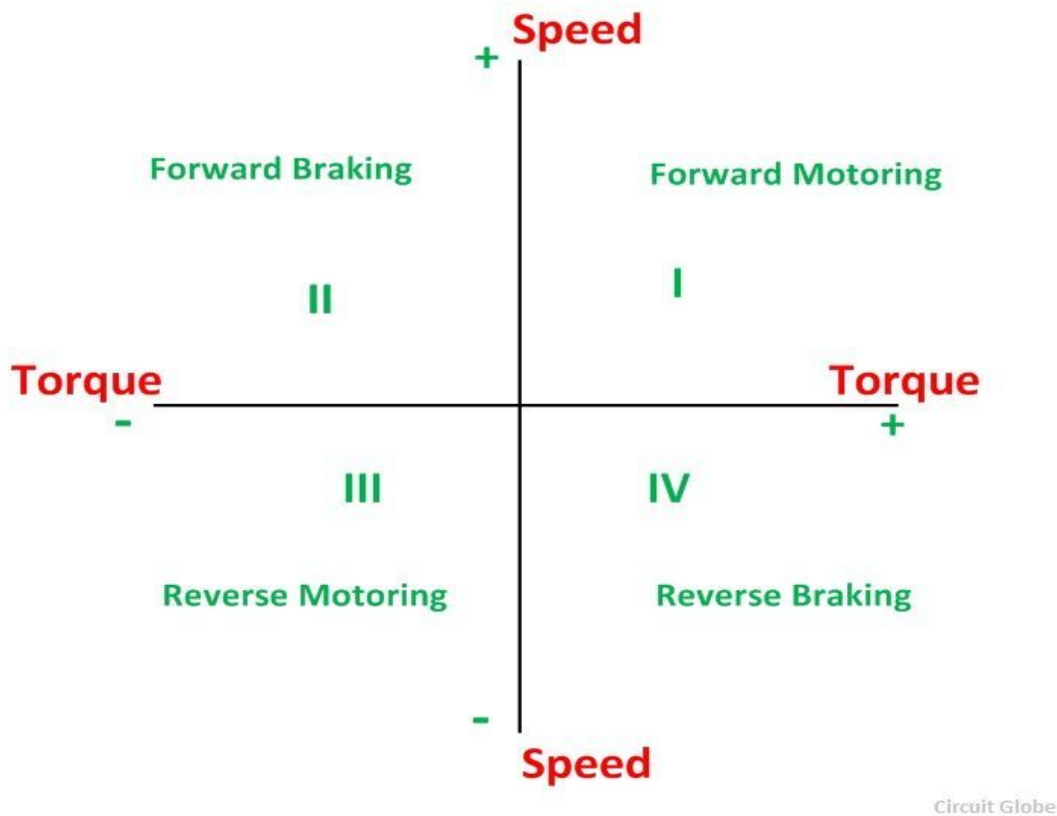
6) **voltage regulator:** The voltage regulator has maintained the constant output voltage which we can apply to the various appliances where it's necessary to induce the fixed amount of the voltage so to maintain, the constant output voltage where using voltage regulator, and it'll provide the constant voltage is respective of change in the input signal for change in the load resistance.

7) **Microcontroller 8051:**

It synchronizes and manages all processes that are carried out in the microcontroller. Microcontrollers are used in automatically controlled products and devices

| Pin | Left | | Right | Pin |
|---|---|---|---|---|
| 1 | P1.0 | | Vcc | 40 |
| 2 | P1.1 | | [AD0]P0.0 | 39 |
| 3 | P1.2 | | [AD1]P0.1 | 38 |
| 4 | P1.3 | | [AD2]P0.2 | 37 |
| 5 | P1.4 | | [AD3]P0.3 | 36 |
| 6 | P1.5 | | [AD4]P0.4 | 35 |
| 7 | P1.6 | | [AD5]P0.5 | 34 |
| 8 | P1.7 | | [AD6]P0.6 | 33 |
| 9 | Reset | | [AD7]P0.7 | 32 |
| 10 | P3.0[RxD] | 8051 | [VPP]$\overline{EA}$ | 31 |
| 11 | P3.1[TxD] | | [PROG]ALE | 30 |
| 12 | P3.2[INT0] | | $\overline{PSEN}$ | 29 |
| 13 | P3.3[INT1] | | [A15]P2.7 | 28 |
| 14 | P3.4[T0] | | [A14]P2.6 | 27 |
| 15 | P3.5[T1] | | [A13]P2.5 | 26 |
| 16 | P3.6[$\overline{WR}$] | | [A12]P2.4 | 25 |
| 17 | P3.7[$\overline{RD}$] | | [A11]P2.3 | 24 |
| 18 | XTAL2 | | [A10]P2.2 | 23 |
| 19 | XTAL1 | | [A9]P2.1 | 22 |
| 20 | Vss | | [A8]P2.0 | 21 |

**Four Quadrant Operation of DC Motor:**



The above figure shows the four-quadrant operation of the DC motor. the first quadrant shows forward motoring the motor speed positive as well as torque is positive. The next quadrant is the second quadrant that shows forward breaking motor speed as positive and torque as negative. the next quadrant is the third quadrant which shows reverse motoring motor speed as negative and torque is negative and the last quadrant fourth quadrant shows the reverse breaking motor speed as negative and torque is positive.

## ADVANTAGE

- requires the much less maintenance
- Safety to use
- It offers a reliable, durable, accurate, and efficient way of speed control of a DC motor
- Connection is simple to understand
- Instantaneous break
- Easy to operate

## APPLICATION

- Robotic managed applications.
- One of these applications embodies electric traction systems, cranes, and lifts, and the engine takes a look at loading systems.
- In business programs like conveyer belts, the right-handed and anticlockwise operation of the DC motor is the important intensity

## FUTURE SCOPE

- It may offer wireless management with the aid of using the use of a transmitter after the microcontroller and a receiver to the motor drive.
- Whole complete automation may be offered offers with the aid of using the use of appropriate sensors.

## CONCLUSION

- It is proved to be operated so simply.
- The hardware for four-quadrant dc motor speed control using a microcontroller is designed.
- In the proposed model, the PWM technique has been used to control the speed of the DC motor.
- We conclude that the motor operates in all four quadrants and how to control the motor.

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