PWM Based Speed Control for a DC Motor

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***Abstract*— This Project is intended to control the speed of a DC motor utilizing PWM control with the 8051 arrangement microcontroller. The speed of the DC motor is specifically corresponding to the voltage connected over its terminals. Subsequently, if the voltage over the motor terminal is shifted, then the speed can likewise be changed. This project utilizes the above guideline to control the speed of the DC motor by fluctuating the duty cycle of the pulse connected to it (prevalently known as PWM control). This project utilizes two info catches interfaced to the microcontroller, which are utilized to control the speed of motor. A motor driver IC is interfaced to the microcontroller for getting PWM flags and conveying fancied yield for the speed control of little DC motor.**

***Keywords*—PWM, Speed Control, Microcontroller, At89s52, L293D**

(1) INTRODUCTION

An Embedded System is a combination of computer hardware and software, and perhaps additional mechanical or other parts, designed to perform a specific function. An embedded system is a microcontroller-based, software driven, reliable, real-time control system, autonomous, or human or network interactive, operating on diverse physical variables and in diverse environments and sold into a competitive and cost conscious market.

There are two ways to control speed of dc motor; mechanically or electrically. As we know mechanical method required large size and cost whereas electrical method required less size. Thus in this project speed control is achieved by using electrical technique. Some important applications are; rolling mills, paper mills, machine tools, traction, printing presses, textile mills and cranes.

The purpose of this project is to take signal representing at required speed of DC motor. Here speed controlling is achieved by us of microcontroller AT89S52/C52 along with L293D motor driver IC.

(2) RELATED WORKS

A reasonable number of works have found in the literature. The paper of khan mason Razal, mohd kamill, pushpendra kumar has studied that the DC motor is widely used in industries for production processes. If we can easy control and smooth operation to dc motor then it's widely used also for commercial purpose.

They also studied that the microcontroller can be used to generate PWM signal and provide automatic speed control of dc motor. L293D driver IC also used to drive the dc motor which is based on H-bridge concept.

(3) MATHODOLOGY

In this project we control the 12V dc motor using 230V power supply. As the system design to control the speed of a dc motor, so the desired goal is to achieve a system with constant speed and smooth operation at any load condition. That means motor will run at fixed speed at any load condition. Also LCD 16*2 provide real time dc motor speed data and voltage level of system at any time, which allows operator to make necessary change in system to prevent any fault or overload condition. The system describes further in brief.

A. Power Delivery

The circuit uses standard power supply comprising of a step-down transformer from 230Vto 12V and 4 diodes forming a bridge rectifier that delivers pulsating dc which is then filtered by an electrolytic capacitor of about 470µF to 1000µF. The filtered dc being unregulated, IC LM7805 is used to get 5V DC constant at its pin no 3 irrespective of input DC varying from 7V to 15V. The input dc shall be varying in the event of input ac at 230volts section varies from 160V to 270V in the ratio of the transformer primary voltage V1 to secondary voltage V2 governed by the formula V1/V2=N1/N2. As N1/N2 i.e. no. of turns in the primary to the no. of turns in the secondary remains unchanged V2 is directly proportional to V1.Thus if the transformer delivers 12V at 220V input it will give 8.72V at 160V.Similarly at 270V it will give 14.72V.Thus the dc voltage at the input of the regulator changes from about 8V to 15V because of A.C voltage variation from 160V to 270V the regulator output will remain constant at 5V.

The regulated 5V DC is further filtered by a small electrolytic capacitor of 10µF for any noise so generated by the circuit. One LED is connected of this 5V point in series with a current limiting resistor of 330Ω to the ground i.e., negative voltage to indicate 5V power supply availability. The unregulated 12V point is used for other applications as and when required.

B. PWM Technique

Pulse-width modulation (PWM) is a commonly used technique for controlling power to an electrical device, made practical by modern electronic power switches. The

average value of voltage (and current) fed to the load is controlled by turning the switch between supply and load on and off at a fast pace.

The longer the switch is on compared to the off periods, the higher the power supplied to the load is. The main advantage of PWM is that power loss in the switching devices is very low. When a switch is off there is practically no current, and when it is on, there is almost no voltage drop across the switch. Power loss, being the product of voltage and current, is thus in both cases close to zero. PWM works also well with digital controls, which, because of their on/off nature, can easily set the needed duty cycle.

The term duty cycle describes the proportion of on time to the regular interval or period of time; a low duty cycle corresponds to low power, because the power is off for most of the time. Duty cycle is expressed in percent, 100% being fully on. The following figure shows the output waveform of pulse width modulation technique.

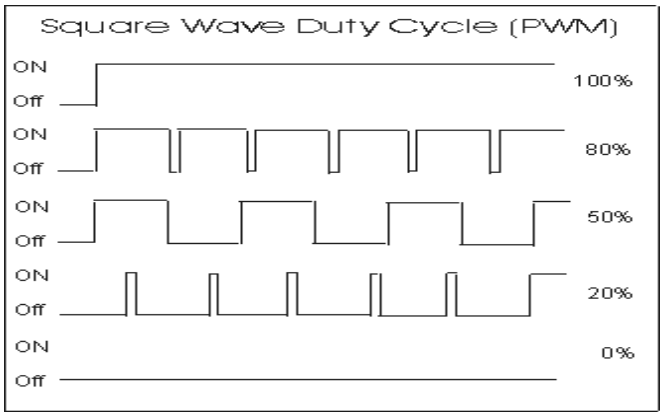


Figure 1.O/P waveform of PWM technique

C. Circuit Description

The output of the power supply, which is 5v connected to the 40th pin of microcontroller and 20th GND. Pin no.15,16,17 of port 3 are connected to Read, Write and Enable pin of LCD display. Pin no.4, 5, 6 of port 1 connected to the input 1, 2, Enable pin of L293D motor driver IC. Two push button switches are provided with pull-up resistor at pin no.12, 13 of a microcontroller which is duly programmed. Two push button switches S2 and S3 are provided with pull up resistor at pin no.12 and 13 of microcontroller. One push button is for increasing the ON time duty cycle of the PWM signal and other switch is for reducing the duty cycle. The motor runs through L293D motor driver IC with varying duty cycle applied to enable pin of L293D. The LCD data pins connected to port 2 and the control pins to port 3.5, 3.6, 3.7 to display the percentage of speed at which the motor is running.

(4) RESULTS AND DISCUSSION

In the result, A pulse width Fixed frequency is generated by microcontroller and drives the motor at different speed by varying duty cycle. A freewheeling diode 1N4007 used for back e.m.f protection for given to the other portion.

D (Duty cycle)	Voltage Using Equation(V)	Voltage Measured by Multimeter(V)
0.1	1.26	3.2
0.3	3.66	3.8
0.5	6.0	10.0
0.7	8.52	11.5
0.9	10.35	11.8

Table 1 motor Terminal Voltage at Various Duty Cycles

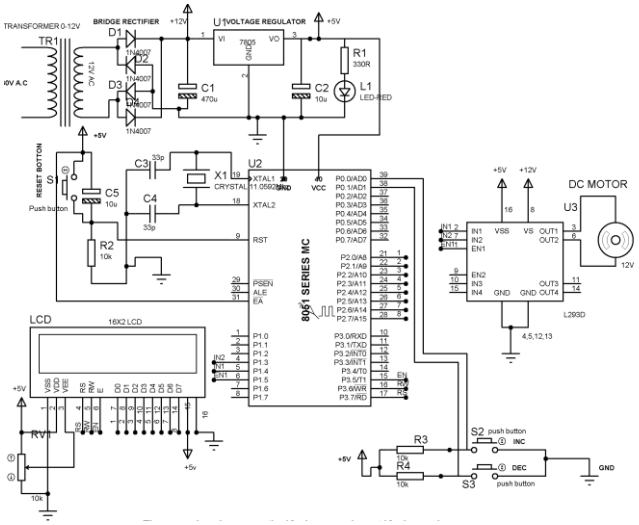
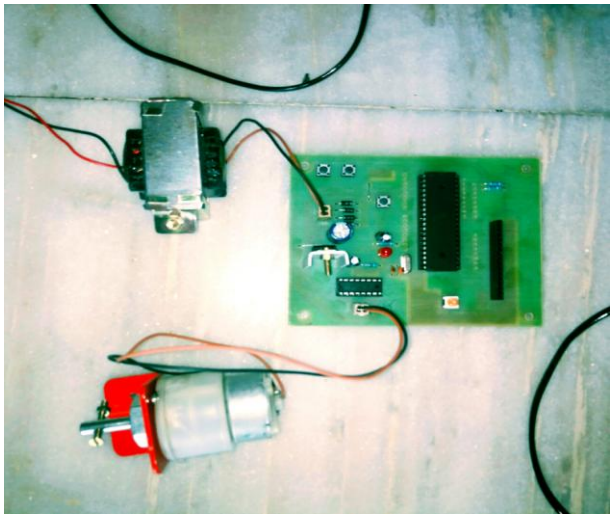


Figure 2 Circuit diagram of system



(5) CONCLUSION

The microcontroller based speed control of DC motor using PWM technique has been introduced. This project is also cost effective, practical and safest way to save power. By using PWM we can vary pulse duty cycle which in turn varies the speed of motor by interchanging output ports, it will effectively change direction of motor.

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