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"Speed Control of DC Motor by using PWM"

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Abstract: In industry DC motor is widely uses for speed control and load characteristics, it's easy controllability provide effective and precise output so application of DC motor is large for commercial purpose. Speed control of DC motor is very crucial in application where required speed is precision and correcting signal representing and to operate motor at constant speed, so we used PWM method which are fulfill all requirements to speed control of DC motor. PWM based speed control system consists of electronic components (integrated circuits, Sensors etc.). In this paper, to control the speed of DC motor using Pulse Width Modulation (PWM) method. Microcontroller AT89S52 is used to generate PWM. L293D IC is used to drive the motor which is made up of two H-Bridge. 555 IC is used with opto coupler to sense the speed of DC motor. Rectifier circuit is used for power supply to circuit and motor. This paper shows that precise and accurate control of small DC motors can be done efficiently without using costly components and complicated circuit.

Keywords: DC motor, H-bridge, Pulse Width Modulation, IR sensor.

1. INTRODUCTION

Speed controllers of DC motor are very useful for controlling the robotic motion and automation systems in industry. In this paper controller presented uses the pulse-width modulation (PWM) technique for speed control of DC motor. Using Atmel AT89S52 microcontroller generate the PWM wave for speed control of DC motor, we need a variable-voltage DC power source to control the speed of the DC motor. When the DC motor is on, it takes certain time to reach at full speed. As soon as the power source is on, the DC motor starts gaining speed and if we switch off the power source before it reaches at rated speed, it starts to goes down. In quick succession of switching on and switching off are done, the motor rotate at a lower speed between zero and rated speed. In this paper we used PWM method so it switches the motor 'on' and 'off' with a pulse wave. The main objective of this paper is to become easy with the implementation of hardware of Amtel AT89S52 microcontroller based speed control of DC motor, L293D IC is used to provide to motor and infrared sensor is used to count the speed which are interface with 555 IC, it give senses of occurring overload to the operator at overload condition and speed display on LCD screen. For the required speed the speed controller takes signal represent and to drive a motor at required speed.

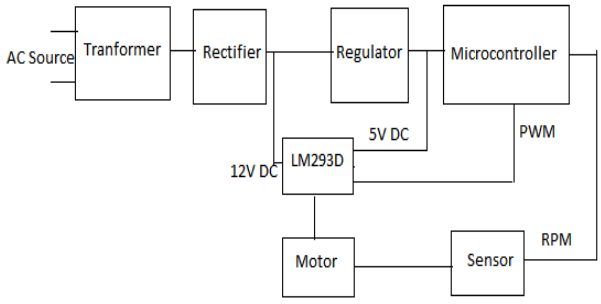

Figure1. Block Diagram

2. METHODOLOGY

A. Pulse Width Modulation

PWM have many of the characteristics of a control system. A simple method to control the speed of a DC motor is to control driving voltage, when the voltage is high the speed would be high. In many applications normal voltage control would cause lot of power loss on control system, so PWM method is mostly used in DC motor speed control application. When applying PWM controlling method, keep in mind that using a motor is as low pass system. PWM method is the high frequency avoided and we know that large motor is mainly inductive so avoid high frequency, hence will not perform well using high frequencies. This method work on low frequency so lower frequency is better than higher frequency. .We can easily understand by example. On an Off time is referred to as "duty cycle". The figure 2 shows the waveforms of 10%, 50% and 90% duty cycle signal. As we can see in figure 2, for 10% waveform 10% duty cycle signal in on and 90% off while a for 90% waveform 90% duty cycle signal is on and 10% off. These signals are send to motor. The end result of the PWM is that power is send to the motor and it can adjust from 0% to 100% duty cycle with stable control and high efficiency.

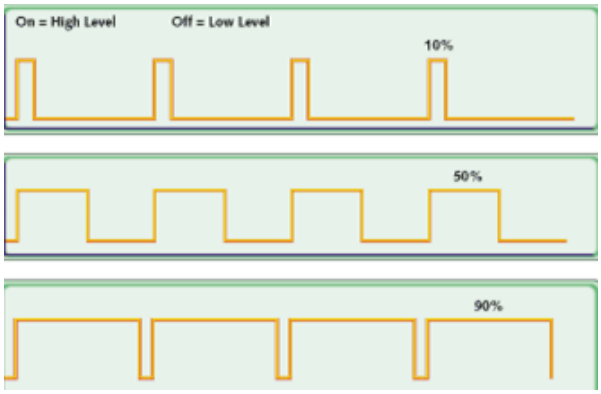

Figure2. Wave form at different duty cycles

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B. power supply

Power supply is main source to operate any electronic base circuit and need of supply should at direct current low voltage, for low voltage we used the step down transformer from 230V AC to 12V DC. After that full wave bridge rectifier is used to convert from AC to DC source for circuit and other components. We can understand the conversion process of supply from figure 3. During the positive half-cycle of voltage, diodes D2 and D4 are conducting and diodes D1 and D3 are reverse bias. Therefore, current flows through the winding, diode D2, load and diode D4. During negative half-cycles of voltage, diodes D1 and D3 conduct, and diodes D2 and D4 are reverse bias, therefore current flow through diode D3, D1 and load. In each condition the current flow in same direction.

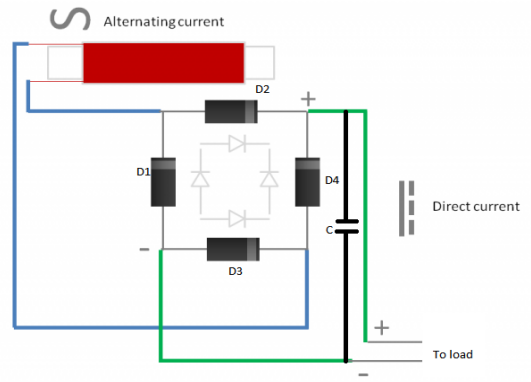

Figure3. Rectifier schematic

C. motor driving IC

Motor Driver IC is primarily used in autonomous robotics, mostly microcontroller operates at low voltages and required small amount current to operate while motor operate relatively higher current and voltage. Thus we cannot supply the current and voltages from microcontroller and this uses of motor driving IC is primary uses. In figure 4 shows motor driving IC with pin description it is consists of 2 H-bridges and two output port are available.

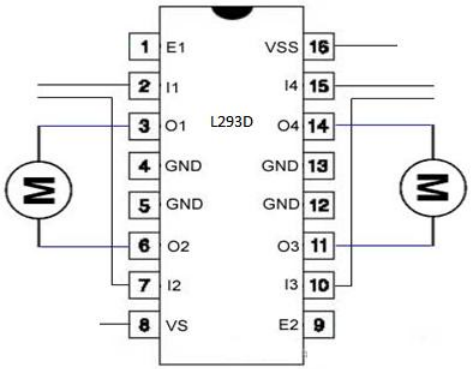

Figure4. Motor driving pin diagram

D. IR Sensor

In this IR detector and transmitter circuit the IC 555 is working under MONOSTABLE mode. The pin 2 trigger pin and when grounded via IR receiver, the pin no. 3 output is low. As soon as the light beam transmitted is obstructed, a momentary pulse gives output (or LED). The IR transmitter is simple and connected in series resistance from battery. The timing capacitor connected to pin 6 and 7 to ground. The time can varied as per requirement by changing. Applications of 555 IC are also pulse generation, pulse width modulation, pulse position modulation, sequential timing, precision timing etc.

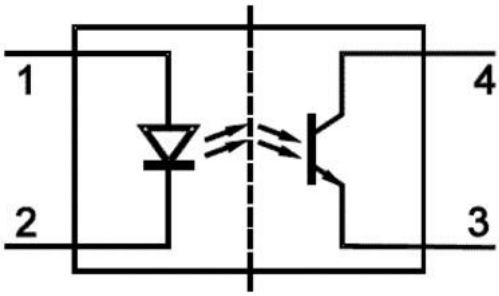

Figure5. IR sensor

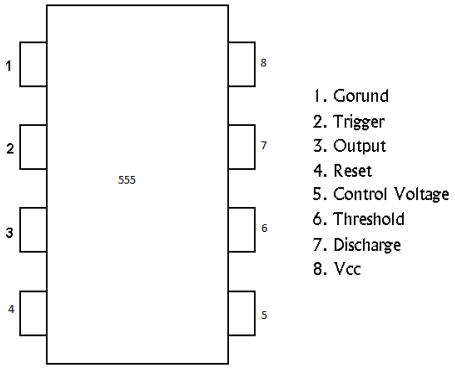

Figure6. 555 IC

E. LCD Display

We will discuss how a 16*2 LCD is interface with AT89S52. LCD 16*2 is used as output by the controller to display data to user. The 16*2 LCD display have 16 number of data can be written on 2 lines. The data may be latter (A-Z) or number (0-9) or any symbols. LCD display we can see in the figure 7 and its connection need some important components which are given below.

Components required:

1. AT89S52 microcontroller.
2. 16*2 LCD display.
3. Capacitors 3- 104 pF
4. Resistors 2- 220 to 1KΩ.

Figure7. LCD display

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3. FUTURE SCOPE

1. DC motor plays a significant role in modern industries. They are widely used in industry because of its low cost, less complex control structure and wide range of speed and torque so better future of this project.
2. In this project we are used pulse width modulation technique, it is a modern technology in solid state field and it provide smooth speed control of motor.
3. Now a day PWM technique are using in fuzzy logic control system, so PWM method is very efficient and reliable method to control the speed of motor so it future is also bright in the modern era with fuzzy logic.

4. HARDWARE

Below shows hardware schematic diagrams in which step wise figure are mentioned with output result of power supply is also mentioned.

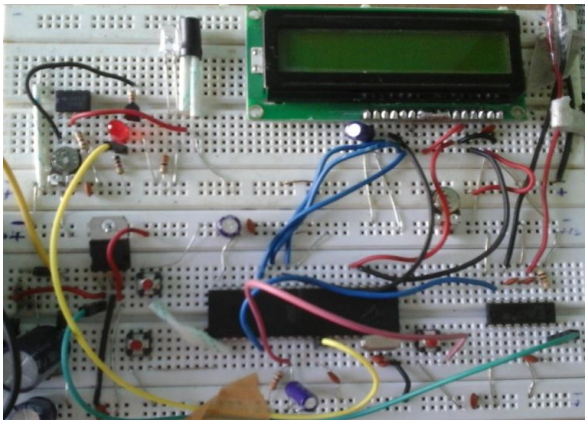

Figure8. Bread board connection diagram during implementation of project

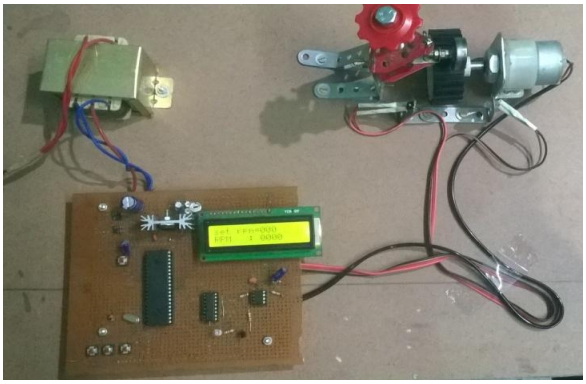

Figure 9. Schematic of circuit after final project with motor and all component combination

In figure 7 shows the bread board connection during implementation of project, all the components are interconnected on board first and then run motor after run we have measure speed of the motor shaft then at no load speed motor give 100% output and when the motor decrease the speed after apply the load on the shaft of motor the speed starts decrease and it reaches below the set value of motor speed then microcontroller generate pulse width modulation signal it gives to the motor driving IC L293D and it increases the voltage of the source and motor regain their speed at desired. This project is tested on bread board then we have made hardware of project and tested power supply given below in figure 8 and 9 respectively.

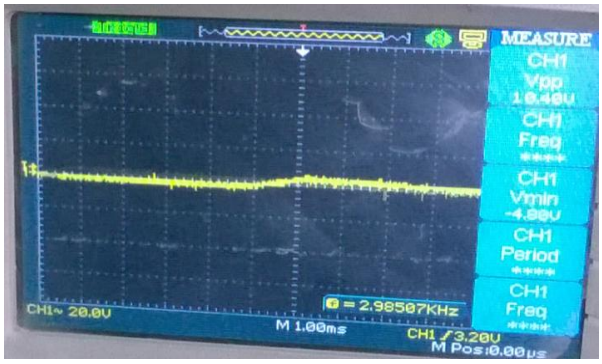

Figure10. Output of power supply after testing on CRO set with verified result.

5. CONCLUSION

We have designed fixed speed control system for DC motor, which has reliability, precision and adaptability for different system ratting with response. It means the motor will run at fixed speed at any load condition. When amount of load is applied the speed does not vary and software is made according to the requirement of speed control. This designed system and implemented automatic speed control system of DC motor, it control the speed of DC motor by using PWM method.

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