RESEARCH ARTICLE OPEN ACCESS

DC MOTOR SPEED CONTROL USING MICROCONTROLLER

Ms Sarita S Umadi[1], Dinesh Patil[2]
(Electrical & Electronics Engineering, AITRC,Vita
(Mechanical Engineering, BIT, Barshi)

Abstract:

The aim of this paper is to control the speed of DC motor. The main advantage in using a DC motor is that the Speed-Torque relationship can be varied to almost any useful form. To achieve the speed control an electronic technique called Pulse Width Modulation is used which generates High and Low pulses. These pulses vary the speed in the motor. For the generation of these pulses a microcontroller (AT89c51) is used. As a microcontroller is used to set the speed ranges which is done by changing the duty cycles time period in the program. This is practical and highly feasible in economic point of view, and has an advantage of running motors of higher ratings. This paper gives a reliable, durable, accurate and efficient way of speed control of a DC motor.

Keywords — **Microcontroller (8051), Dc Motor,PWM**

1 INTRODUCTION: The direct current (DC) motor is a device that used in many industries in order to convert electrical energy into mechanical energy. This is all result from the availability of speed controllers is wide range, easily and many ways. In most applications, speed control is very important. For example, if we have DC motor in radio controller car, if we just apply a constant power to the motor, it is impossible to maintain the desired speed. It will go slower over rocky road, slower uphill, faster downhill and so on. So, it is important to make a controller to control the speed of DC motor in desired speed.

DC motor plays a significant role in modern industry. The purpose of a motor speed controller is to take a signal representing the demanded speed, and to drive a motor at that speed. There are numerous applications where control of speed is required, as in rolling mills, cranes, hoists, elevators, machine tools, transit system and locomotive drives. These applications may demand high-speed control accuracy and good dynamic responses.

In home appliances, washers, dryers and compressors are good example. There are many applications in our life that requires DC motor speed control. In conclusion, the simplicity of control speed made DC motors to be common in devices ranging from toys, house appliance and robotics to industrial application.

Todays industries are increasingly demanding process automation in all sectors. Automation results into better quality, increased production an reduced costs. The variable speed drives, which can control the speed of A.C/D.C motors, are indispensable controlling elements in automation systems. Depending on the applications, some of them are fixed speed and some of the variable speed drives. **Direct current (DC) motors** have been used in variable speed drives for a long time.

Basically, this paper is listing three main objectives:
i. To design the hardware of the controller to control DC motor speed.

ii. To develop controller using microcontroller as programming.
iii. To develop precisely control the DC motor.

2 LITERATURE REVIEW: The main purpose of this paper is to analyze, identify and make conclusion based on this paper. A literature review means a collecting related data, analyzed business process, identify underlying patterns and create a conclusion. Another description of the literature review is a systematic, explicit and reproducible method to identifying evaluating and synthesizing the exiting body of completed and recorded work produced by researcher, scholars and practitioners.

In order to develop a successful project, the current system is identified. The system of conventional DC motor speed control based on microcontroller is analyzed. Studies of these system are significant to develop a valid, reliable and efficient up grade project. The literature review part acts as a mean to discover which methodology should be chosen in developing this system.

Facts and Findings established what the existing system does and the problem are and leads to a definition of a set of options from which users may choose their required system. This section will be discussing about the domain of this project, the existing system and finally the other techniques that applicable to be used while developing this project. It focused on the how to design and develop the project systematically according to the requirement of minimize the functional of conventional project. In the other situation, these will be describing any element or method which is useful to be used for the purpose of searching and gathered useful information in developing this project.

3 SPEED CONTROL METHODS IN A DC MOTOR:-

The motor speed can be controlled by controlling armature voltage and armature current. It is obvious that speed control is possible by varying

• Flux per pole, Φ (Flux control)
• Resistance Ra of armature circuit (Rheostat Control)
• Applied voltage V (Voltage Control)

The above methods have some demerits like a large amount of power is wasted in the controller resistance. Hence, efficiency is decreased. It needs expensive arrangement for dissipation of heat produced in the controller resistance. It gives speeds below the normal speed. By these data that are acquainted we can draw a conclusion that these electric and electromechanical methods are less adaptive so electronic techniques are used for speed control. These methods provide higher efficiency, greater reliability, quick response, higher efficiency. One such technique is Pulse Width Modulation. We apply this technique in our project so as to control the speed of the DC motor.

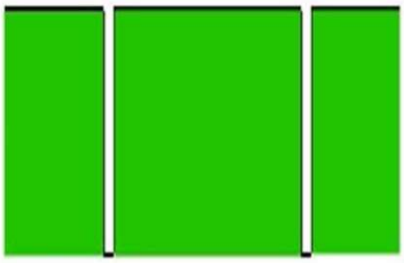
4 PULSE WIDTH MODULATION (PWM)

Pulse width modulation (PWM) is a method for binary signals generation, which has 2 signal periods (high and low). The width (W) of each pulse varies between 0 and the period (T). The main principle is control of power by varying the duty cycle. Here the conduction time to the load is controlled. Let for a time t1, the input voltage appears across the load i.e. ON state and for t2 time the voltage across the load is zero.

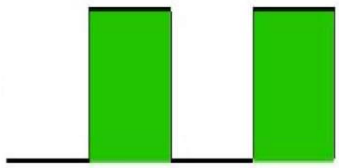
Pulse-width modulation (PWM), as it applies to motor control, is a way of delivering energy through a succession of pulses rather than a continuously varying (analog) signal. By increasing or decreasing pulse width, the controller regulates energy flow to the motor shaft. The motors own inductance acts like a filter, storing energy during the “on” cycle while releasing it at a rate corresponding to the input or reference signal. In other words, energy flows into the load not so much the switching frequency, but at the reference frequency.

4.1 High Speed Signal (90%): The green part of the signal represents the ON time and the white

part of it represents time when it is not receiving any voltage



4.2 Signal with half voltage (50%):



5 BLOCK DIAGRAM:-

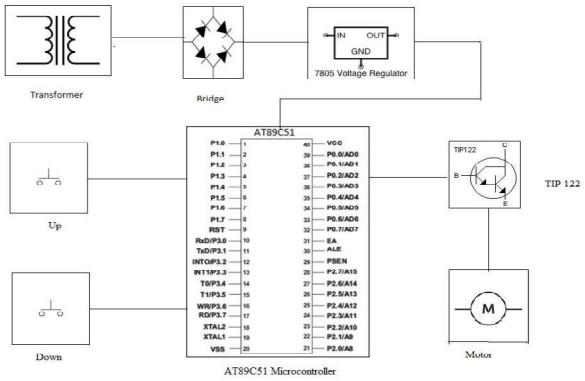


Fig 5.1:Block Diagram

5.1 5v & 12v Dc Power Supply

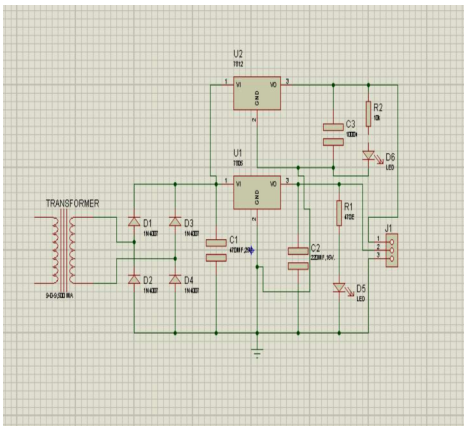


Fig: 5v & 12v Dc Power Supply

5.2 Working principle of DC power supply:-

The AC voltage, typically 220V RMS, is connected to a transformer, which step down AC voltage to the level of the desired DC output. A diode rectifier then provides a full-wave rectified voltage that is initially filtered by a simple capacitor filter to produce a dc voltage. This resulting dc voltage usually has some ripple or ac voltage variation. A regulator circuit removes the ripples and also remains the same dc value even if the input dc voltage varies, or the load connected to the output dc voltage changes.

6 CIRCUIT DIAGRAM

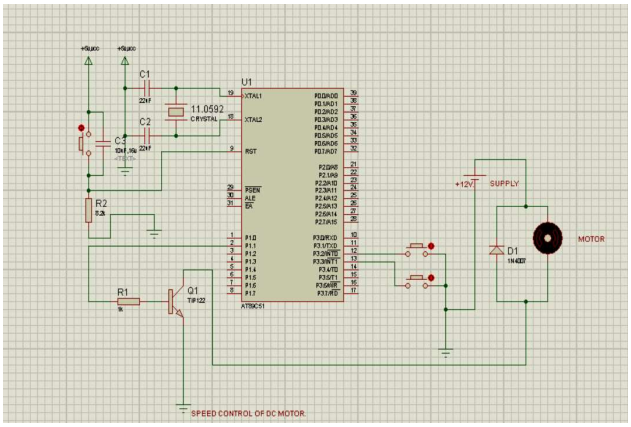


Fig 6.1: circuit diagram of microcontroller based DC motor speed controller.

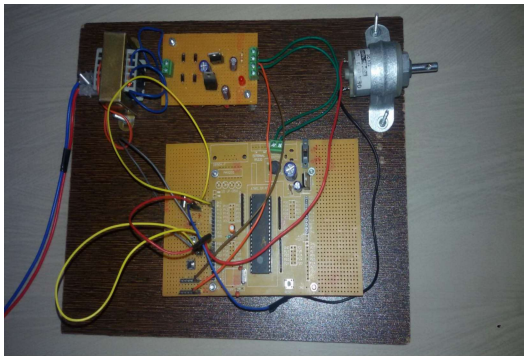
6.1 OPERATION:-

Above figure shows the circuit of the DC motor speed controller. 230V, AC mains is stepped down by transformer X1 to deliver secondary output of 12V, 500mA. The secondary output is rectified by a full-wave bridge rectifier comprising diodes D1 through D4, filtered by capacitor C1 and regulated by IC 7805(IC1). Capacitor C2 bypasses any ripple present in the regulated output. LED1 acts as the power-„on" indicator. Resistor R1 limits the current passing through LED1. IC AT89C51 (IC2) is a low-power, high-performance, 8-bit microcontroller. At the heart of the speed controller system is microcontroller AT89C52 (IC2), which creates (using timer 0) pulses of varying width for pulse width modulation and controls the motor speed. To change the speed of the motor, switches S2 and S3 are interfaced to interrupt the input to pins P3.2 and P3.3 of IC2, respectively.
Whenever any of switches S2 and S3 is pressed, an interrupt is generated, which changes the duty cycle of the pulse train. Switch S2 interfaced to Interrupt-0 increases the duty cycle of the pulse waveform, whereas switch S3 interfaced to Interrupt-1 decreases the duty cycle of the pulse waveform. Power-on reset for the microcontroller is achieved through capacitor C6 and resistor R2. Switch S1 provides manual reset to the microcontroller. A 12MHz crystal (XTAL) is used for basic clock frequency.

Port pin P1.1 is internally pulled cup. It is used as the output to control the motor with driver transistor T1. Whenever timer-0 overflows, the status of pin P1.1 is complemented and hence a square wave with appropriate duty cycle is generated. This pin is interfaced to power transistor TIP122 (T1), which is used to drive the motor. When the transistor is driven into saturation, current flows through the motor. When the transistor is cut off, the motor current keeps flowing because of the motor"s inductance. Diode D6 connected across the motor coil prevents reverse current flow.

The software is written in „C" language and compiled using Keil C compiler, which generates Intel hex code for the microcontroller. The µVision3 integrates all tools including the „C" compiler, micro assembler, linker/locator and hex file generator. The generated hex code is burnt into the microcontroller using a suitable programmer. Whenever any switch is pressed, the duty cycle of PWM varies. The software then calculates the appropriate values for TH0 and TL0 for „on" and „off" time of the output, which are copied in TH0 and TL0 on timer interrupts.
In this circuit, we have used timer-0 of the microcontroller for generating PWM pulses, which is clocked using a 12MHz crystal oscillator. The base frequency is kept constant at 1 kHz and the duty cycle of this wave is varied to change the analogue level at output pin P1.1 of the microcontroller.

6.2 Hardware setup:



CONCLUSION:

This project brought together several components and ideas to achieve a common goal: to prove that it is possible to run DC series motor on variable speed using PWM. We put a lot of time into achieve a variable speed of DC series motor and to perform best it possibly could. Now that the project as a whole is finished, we hand it over to future generations to design and improve each component. Possibly future projects may include.
1) Design of circuit: The circuit designing is done on the zero PCB but temporary we use rough Circuit dig. And then zero PCB use for designing (mounting) the circuit.
2) Design of power supply: Then we design the power supply of 12v, by using IC7805 we obtain the constant power supply of 12V&5V.
3) Burning of coding: We make the program in C language and burn it using universal burner with

Top wall software. And compare the speed which can be vary according to PWM.

7 FUTURE SCOPE

The speed control of the DC motor is important because its speed can be changed over a wide variety of simple methods which is not possible in an AC motor.

The total voltage of the batteries or DC power source connected to a shunt motor affects how first it moves. Increasing the DC voltage will make the shunt motor run faster.

In future if this motor is used in fans then we can get variable speed by just pressing of push buttons.

REFERENCES:

1] *Y. S. E. Ali, S. B. M. Noor, S. M. Uashi and M. K Hassan" Microcontroller Performance for DC Motor Speed Control" O-7803-8208©2003 IEEE.*

2] Speed Control Of DC Motor Using Analog PWM Technique Nandkishor P. Joshi,Member ISTE1 , Ajay P. Thakare,Member IEEE,Member ISTE2

3] N. Milivojevic, Mahesh Krishnamurthy and Yusuf Gurkaynak," Stability Analysis of FPGA- Based Control of Brushless DC Motors and Generators Using Digital PWM Technique", IEEE Transactions on Industrial Electronics, Vol. 59, no. 1, January 2012 [3] Hong Wong and Vikram Kapila, "Internet-Based Remote Control of a DC Motor using an Embedded Ethernet Microcontroller"

4] Abu Zaharin Ahmad and Mohd Nasir Taib. A study on the DC Motor Speed Control byUsingBack-EMF Voltage. Asia sense sensor, 2003, pg. 359-364 [8] Chia-An Yeh and Yen-Shin Lai,"Digital Pulsewidth Modulation Technique for a Synchronous Buck DC/DC Converter to Reduce Switching Frequency", IEEE Transactions on Industrial Electronics, Vol. 59, No. 1, January 2012

5] Zhen yuyu, "Space-vector PWM with TMS320C24x/F24x using hardware and software determined switching patens," SPRA524, pp.4-5, Texas Instruments, March 1999

6] A text book by mazidi and Mazidi and Ayla