Managing Speed of DC motor using Microcontroller

[1]Shubham Ingle, [2]Akash Gunjvate,[3]Vipul Galkar, [4]Mukesh Chavhan,[5]Prof. Pragati Rathi
, [1,2,3,4,]Student, [5]Assistant Professor
[1,2,3,4,5]Department of Electrical Engineering
[1,2,4,4,5]Sanmati Engineering College , Washim, India

Abstract : Direct Current (DC) motor has already become an important drive configuration for many applications across a wide range of power and speeds. The case of control and excellent performance of the DC motors will ensure that the numbers of applications using them will continue grow in future. This paper is mainly concerned on DC motor speed control system in addition with the change in running mode, directions, time setting in different ways by using microcontroller AT89C1. It is close loop control system. This paper presents speed control of DC motor using an ATMELS 89C51 microcontroller. The speed of DC motor is directly proportional to the voltage applied across its terminals.

In this paper we have use several types of IC's such as Inverter IC (74LS04), Motor driver IC(L293D), Timer ICNE555, AT89C51 IC from which microcontroller IC AT89C51 is the man IC or we can say it is the heart of the project. The paperuses eight input buttons interfaced to the microcontroller, which are used to control the speed, running mode, directions, time setting of motor. The descript information of the functions of switches is given in the paper further. PWM (Pulse Width Modulation) is generated at the output by the microcontroller as per the program. Microcontroller AT89C51 IC gives variable options. With the help of this IC we can display as well as LED light indicators to show the functioning of the different switches.

By the use of different IC's, sensors, relays, we can perform the various functions on the motor. There were many microcontroller IC's which can be use to control the DC motor but with the help of microcontroller IC AT89C51 we can perform various actions on a single panel.

***IndexTerms* - Dc motor, Microcontroller, motor driver, PWM.**

I. INTRODUCTION

In this paperwe introduce a system that can regulate the speed, direction of rotation, and the running mode of DC motor with the help of different switches. It then displays the corresponding messages on an LCD. Motion control plays a vital role in industrial automation. Manufacturing plants in industries like chemical, pharmaceutical, plastic and textile all require motion control. And it may be a flat-belt application, flow control application or mixing of substances. Different types of motors AC, DC, servo or stepper are used depending upon the application. Of these, DC motors are widely used because controlling a DC motor is somewhat easier than other kinds of motors.

The motion of a DC motor is controlled using a DC drive. DC drive changes the speed and direction of motion of the motor. Some of the DC drives are just a rectifier with a series resistor that converts standard AC supply into DC and gives it to the motor through a switch and a series resistor to change the speed and direction of rotation of the motor. But many of the DC drives have an inbuilt microcontroller that provides programmable facilities, message display on LCD, precise control and also protection for motors. Using the DC drive you can program the motion of the motor, i.e., how it should rotate.

In train and automotive traction, fuel pump control, electronic steering control, engine control and electric vehicle control are good examples of these. In aerospace, there are a number of applications, like centrifuges, pumps, robotic arm controls, gyroscope controls and so on. For precise speed control of servo system, closed-loop control is normally used.

The maximum output current of microcontroller pin is 15mA at 5V. But the power requirements of most of DC motors is out of reach of the microcontroller and even the back emf (electro motive force) which is produced by the motor may damage the microcontroller. Hence, it is not good to interface DC motor directly to the controller. So, we use motor driver circuit in between a DC motor and the Microcontroller. The main microcontroller IC used is AT89C51. All the functions performed by motor are control through the instructions given by this IC.

1.1 Direction Control

To control a DC motor from a microcontroller, you use switching arrangement known as an H bridge. It looks like this:

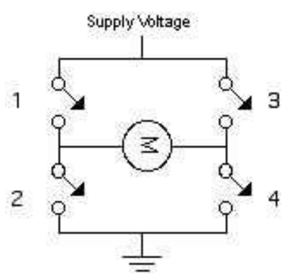

Figure No. 1 H -bridge

When switches 1 and 4 are closed and 2 and 3 are open, voltage flows from the supply to 1 to the motor to 4 to ground. When 2 and 3 are closed and 1 and 4 are open, polarity is reversed, and voltage flows from the supply to 3 to the motor to 2 to ground.

An H-bridge can be built from transistors, so that a microcontroller can switch the motor, like this:

You can see that there are six transistors here; the outer two are used to switch the inner four, in pairs, so that the proper two transistors always switch together. If you were using this circuit, you'd want to make sure that control pins 1 and 2 were always reversed; when one is high, the other is low.

II. LITERATURE REVIEW

1) Prabha Malviya (PG Student) , Menka Dubey(Sr. Asst.prof.) EX department, Malwa institute of Technology, Indore R.G.P.V. Bhopal, India

This paper deal with various method of speed control of DC Motor and literature review on speed control of DC motor is presented. DC motors are widely used in industry applications, robotics and domestic appliances because of its low cost and less complex control structure and wide range of speed and torque. So wide range of position control is required. Proportional Integral Derivative (PID) controller is used in industries for wide number of applications .The tuning of PID controller parameters is very important for desired out response there is so many techniques for tuning of PID controller. PID means Proportional Integral Derivative.

2. Design and Implementation of an AT89C52 Microcontroller Based Water Pump Controller BY Olufemi O. Kehind, Oladayo O. Bamigboy and Fredrick O. Ehiagwina ,Offa Kwara State, Nigeria.

This paper developed a microcontroller based water pump controller aimed reducing water wastages and pump failures, due to not switching it off immediately when not needed. The control system from which water level of both tanks are observed with simultaneous water pump control is based on existing water level technology using the principle of ultrasound for level sensing. A prototype of the proposed microcontroller based water pump controller was fabricated and tested. This paper provided an improvement on existing water level controllers by its use of calibrated circuit to indicate the water level and use of DC instead of ac power, thereby eliminating risk of electrocution.

3. Dc motor speed control using Microcontroller (Ms Sarita S Umadi1, Dinesh Patil2 (Electrical & Electronics Engineering, AITRC,Vita (Mechanical Engineering, BIT, Barshi)

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.

4. Speed Control of DC Motor Using Microcontroller (Prathmesh A. Askar ,Piyush P. Naphade, Ajaykumar R. Jupaka) (EE Department, PCE Nagpur, India)

This paper presents speed control of DC motor using an 8051 series microcontroller. The speed of DC motor is directly proportional to the voltage applied across its terminals. Hence, if voltage across motor terminal is varied, then speed can also be varied. This paper uses the above principle to control the speed of the motor by varying the duty cycle of the pulse applied to it. The paper uses two input buttons interfaced to the microcontroller, which are used to control the speed of motor.

III. PROPOSED METHODOLOGY

Fig.shows the circuit of the microcontroller-based DC motor controller. At the heart of the DC motor controller is microcontroller AT89C51. Port pins P0.0 through P0.7 of the microcontroller are interfaced with data pins D0 through D7 of the LCD module, respectively. Port pins P3.0, P3.1 and P3.2 control the LCD operation through enable (E), register-select (RS) and read/write (R/W) pins, respectively. Contrast of the LCD is set by preset VR1. Port pins P1.0 through P1.7 are connected to switches S1 through S8 for performing the various operations.

Power-on reset signal for the microcontroller is generated by the combination of capacitor C1 and resistor R1. Switch S9 provides manual reset to the microcontroller. A 12MHz crystal provides the basic clock frequency to the microcontroller. Capacitors C2 and C3 provide stability to the

oscillator. EA pin (pin 31) of the microcontroller is connected to 5V to enable internal access. Port pins P2.0 through P2.3 of the microcontroller are used for LED indication of run, stop, clockwise and anti-clockwise rotation. Port pins P2.4 through P2.6 are connected to the inputs of inverters N3, N2 and N1 of 74LS04 (IC2). The output of inverter N3 is used to trigger pin 2 of NE555 timer.

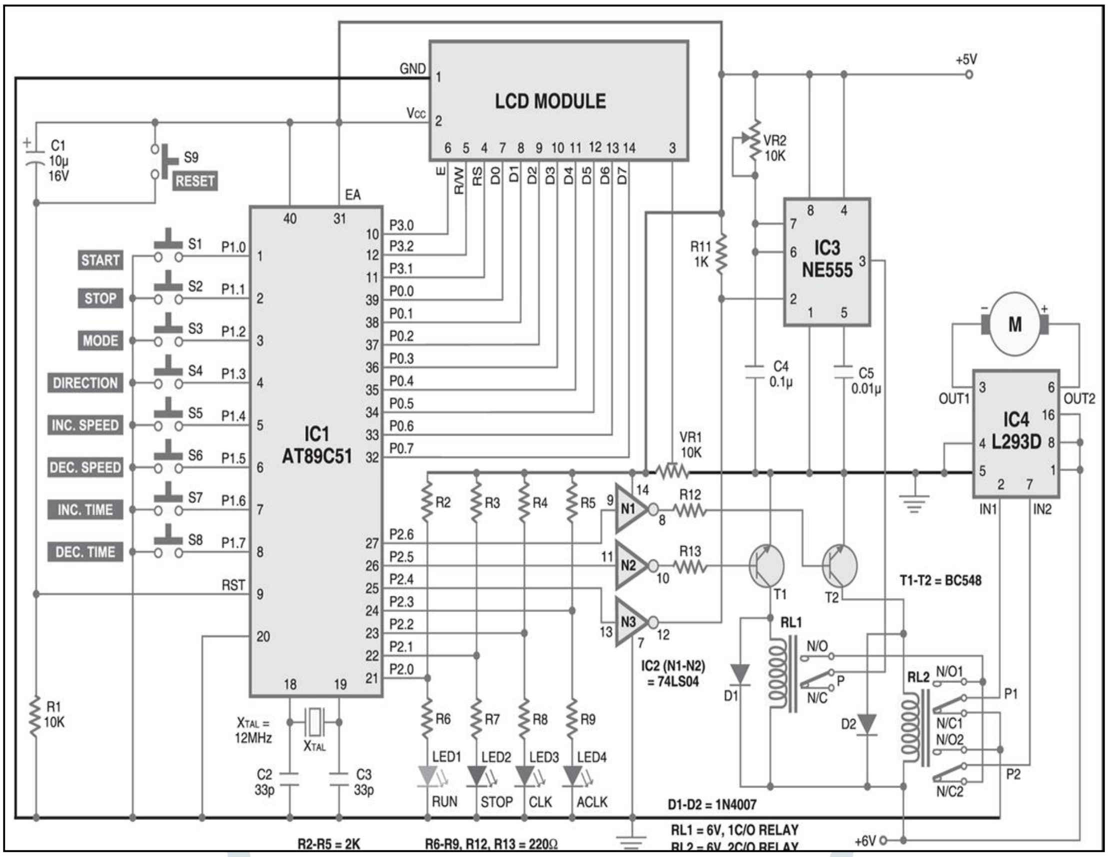

Figure 2. Circuit of the microcontroller based DC motor controller

Timer NE555 is configured as a monostable and its time period is decided by preset VR2 and capacitor C4. When pin 2 of NE555 go e s l ow, output pin 3 becomes high for the predetermined period.

The output of NE555 is connected to pole P of relay RL1. Normally-open (N/O) contacts of relay RL1 are connected to N/O1 and N/ C2 contacts of relay RL2. N/C1 and N/ O2 contacts of RL2 are connected to ground. The outputs of inverters N2 and N1 drive relays RL1 and RL2 with the help of transistors T1 and T2, respectively. D1 and D2 act as free-wheeling diodes. Poles P1 and P2 of RL2 are connected to IN1 and IN2 pins of motor driver L293D. OUT1 and OUT2 of L293D drive motor M.

When S1 is pressed, the microcontroller sends low logic to port pin P2.5. The high output of inverter N2 drives transistor T1 into saturation and relay RL1 energies. So the output of NE555 is fed to inputs IN1 and IN2 of L293D through both the contacts of relay RL2. Now at the same time, after RL1 energies, the microcontroller starts generating PWM signal on port pin P2.4, which is fed to trigger pin 2 of NE555 through inverter N3. The base frequency of the generated PWM signal is 500 Hz, which means the time period is 2 ms (2000µs). The output pulse width varies from 500 µs to 1500 µs. The R-C time constant of the monostable multivibrator is kept slightly less than 500 µs to generate exactly the same inverted PWM as is generated by the microcontroller.

When switch S2 is pressed, port-pin P2.5 goes high and RL1 de-energies to stop the motor. When switch S3 is pressed, relay RL2 energies. Pin IN1 of motor driver L293D receives the PWM signal and pin IN2 connects to ground. As a result, the motor rotates in one direction (say, clockwise).

When switch S4 is pressed, relay RL2 de-energizes. Pin IN2 of motor driver L293D receives the PWM signal and pin IN1 connects to ground. The motor now rotates in opposite direction (anti-clockwise). When switch S3 is pressed, different modes are selected in cyclic manner as given below

1. Continuous mode: The motor rotates continuously with the set speed in either direction
2. Reversible mode: The motor reverses automatically after the set time
3. Jogging mode: The motor rotates for the set time in either direction and then stops for a few seconds and again rotates for the set time. It is also called 'pulse rotation'

Switches S5 and S6 are used to set the speed of the motor, either in increasing order or decreasing order, in continuous mode only. Switches S7 and S8 are used to set the time either in increasing order or decreasing order.

IV. CONCLUSION

In this work, a microcontroller based DC motor control system design is described to change the speed and direction of rotation of DC motor. Armature voltage is varied by pulse width modulation (PWM) of input DC voltage. Direction of rotation of DC motor is changed by initiating an interrupt signal to the microcontroller. To drive the DC motor, a four channel monolithic integrated driver circuit with diode clamps was used. PCB of the control circuit was been designed and the whole system is implemented on it. Test results are presented in tabular form and it shows very good agreement with the expected output.

Field flux can be controlled to vary the speed of the DC motor using the same circuit. In that case driver circuit may be required. Feedback may be incorporated in the system to make it close loop control system. Protection from the maximum input voltage, maximum speed of DC motor etc. may be incorporated in the software

Applications

- Industrial automation
- Manufacturing plants
- Chemical industries
- Pharmaceuticals industries
- Plastic and textile industries

REFERENCES

[1] Remya Ravindran, Arun Kumar," A DC Motor Speed Controller usingLABVIEW and Visual Basic", IJECT Vol. 3, Issue 1, Jan. - March2012.

[2] 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] Rohit Gupta, Ruchika Lamba and Subhransu Padhee, "Thyristor BasedSpeed Control Techniques of DC Motor: A Comparative Analysis", International Journal of Scientific and Research Publications, Volume2, Issue 6, June 2012.

[4] Ajay P. Thakare,Member IEEE,Member ISTE2 Department of Instrumentation and control, SCET, Surat1, Department of Electronics Engineering, SIPNA, Amravati, Vol. 1 Issue 9, November- 2012.

[5] Muhammad H. Rashid, ‘‘Power Electronics Circuits, Devices, and Applications," Prentice Hall, 3rd edition, 2003.

[6] Muhammad H. Rashid Power Electronics Circuits, Devices and Applications 3rd edition. United States of America: Prentice Hall 2004.

[7] Christopher A. Adkins and Michael A. Marra, modeling of a PhaseLocked Loop Servo Controller with Encoder Feedback. IEEEn Spectrum, August 1999.

[8] Moore, A.W. Phase-Locked Loops for Motor-Speed Control, IEEE Spectrum, 1993, pp.61-67.

[9] P. C. Sen and M. L. MacDonald. Thyristorized DC Drives with regenerative braking and Speed Reversal. IEEE Transactions on energy nconversion, 1978, Vol. IECI - 25, no. 4:347-354.

[10] Abu Zaharin Ahmad and Mohd Nasir Taib. A study on the DC Motor speed control by using back-EMF voltage asia SENSE SENSOR 2003.,359-364.

[11] Iovine John. PIC Microcontroller Project Book. 2nd edition. Singapore: McGraw-Hill.

[12] Sjhinskey, FG.Process control systems. 2ndEdition, Singapore: McGraw-Hill Book Company, 2003.