ISSN: 2277-9655
Scientific Journal Impact Factor: 3.449
(ISRA), Impact Factor: 2.114

IJESRT

INTERNATIONAL JOURNAL OF ENGINEERING SCIENCES & RESEARCH TECHNOLOGY

PWM CONTROL CHOPPER FED CLOSED LOOP DRIVE FOR DC MOTOR USING MICROCONTROLLER

Trupti Gajbhiye*, B.S Dani

* Electrical Engineering Department Priyadarshani College of Engineering.
Electrical Engineering Department Priyadarshani College of Engineering.

ABSTRACT

The main characteristics of an electric drive system are reliability, variable speed, high performance are used due to which it can be easily control. The speed control of dc motor is very important because protection and precision are used . The main aim of motor speed control is its takes signal which represents the required speed and drive the motor at that speed. The easy way to control the dc motor is provided by microcontroller. In this paper, the speed control of dc motor has been investigated by the use of an ATmega8L microcontroller. The high frequency PWM signal is driven by the chopper. This work has high feasibility and accuracy according to economic point of view. The main objective of this system is to achieve a constant speed at an different loading condition.

KEYWORDS: ATmega8L, DC motor Microcontroller, PWM ,Speed control.

INTRODUCTION

DC motor is defined as the electromagnetic rotating machine which converts a DC electrical energy into a rotary mechanical energy. Constructionally , the DC motor is same as the DC generator. The same DC machine can function as DC generator giving DC electrical power output when driven by a suitable prime mover and as a DC motor producing mechanical rotary power provided by the DC electrical input supply.AC motors are used commonly as compared with DC motors because AC motors are cheap , compact and smaller in size. DC motors are widely used where wide range of speeds and good speed regulation are required.

By using mechanical and electrical techniques the speed control of dc motor is achieved. It is widely used in paper mills , textile mills, rolling mill, machine tools, traction, mine winders, printing press, canes and excavator. Fractional horsepower of an dc drives are mostly used for tracking and positioning. The control rectifier of an fixed dc voltage gives a variable dc voltage due to this the control rectifier and dc chopper have been used in modern industrial equipments along with the digital chips transistor thyristor are used for controlling the circuits of dc drive . Latest development in the field of semiconductor technology have made microcontroller and microprocessor which is available at an low cost. The main aim of these is to use both hardware and software of the microcontroller based closed loop speed control.

LITERATURE SURVEY

1) "A Microcontroller based Power Electronic Controller for PV assisted DC motor Control S. Krithiga, and N. Ammasai Gounden"

This paper represents a PIC microcontroller based closed loop scheme for the speed control of a separately excited DC motor fed from PV array is used. An IGBT based boost converter is used as an interface between PV array and the DC motor. The microcontroller has been programmed to automatically vary the duty cycle of the boost converter depending upon the set/required speed of the motor.

2) "Micro Controller Based Adjustable Closed-Loop DC Motor Speed Controller" Y. S. Ettomi, S. B. M. Noor, S. M.'Bashi and M. I. Hassan Department of Electrical and Electronic Engineering Faculty of Engineering, University Putra Malaysia UPM Serdang, Selangor, Malaysia

In this paper, the use of micro-controller for speed control and protection of dc motor is presented. The

ISSN: 2277-9655
Scientific Journal Impact Factor: 3.449
(ISRA), Impact Factor: 2.114

peculiarity of this method is its adaptability to different ratings of motors. Experimental results shows the employment of microcontroller for acceleration, speed reversal, and deceleration and over current protection of a dc motor.

3) "Modelling, Simulation and Implementation of Speed Control of DC Motor Using PIC 16F877A" Payal P.Raval1, Prof.C.R.mehta2 1PG Student, Electrical Engg. Department, Nirma University, SG Highway, Ahmedabad, Gujarat, India. 2Asst. Prof. Electrical Engg. Department, Nirma University, SG Highway, Ahmadabad, Gujarat, In this paper, control techniques of PIC 16F877A microcontroller and MOSFET, mechanism assignments of analyzed by mainly focusing with the "Modeling and Simulation of DC Motor using MATLAB". The objective of this paper is to explore the approach of designing a microcontroller based closed loop controller. The interface circuit and the software are all designed to achieve a better performance

4) "International Journal of Engineering Research (ISSN : 2319-6890) Volume No.1, Issue No.2, 01 Dec. 2012 "Controlling DC Motor using Microcontroller (PIC16F72) with PWM" Shruti Shrivastava, Jageshwar Rawat, Amit Agrawal Department of Electronics and Telecommunication Takshshila Institute of Engineering and Technology, Jabalpur, India.

This paper is mainly concerned on DC motor speed control system by using microcontroller PIC 16F72. It is a closed-loop real time control system, where optical encoder (built in this project) is coupled to the motor shaft to provide the feedback speed signal to controller. Pulse Width Modulation (PWM) technique is used where its signal is generated in microcontroller.

Different methods for controlling the speed of dc motor

There are three methods of controlling the speed of the shunt and separately excited dc motor

1. Armature control method.
2. Field control method.
3. By using chopper.
4. By using microcontroller

The comparison between traditional and new method (Chopper control method) . In this Speed does not remain constant i.e. fluctuation in speed occur during loading condition that's why traditional speed control method has not been used here.

MICROCONTROLLER

Figure shows the block diagram of an typical microcontroller , which is a true computer on chip. The design incorporates all of the features found in a microprocessor CPU: ALU, PC , SP, and registers. It has also added the other features needed t make a complete computer: ROM, RAM, parallel I/O , serial I/O, counters and clock circuit.

Like the microprocessor, a microcontroller is a general purpose device, but one that is meant to read data, perform limited calculations on that data and control its environment based on those calculations. The prime use of microcontroller is to control the operation of a machine using a fixed program that is stored in ROM and does not change over the lifetime of the system

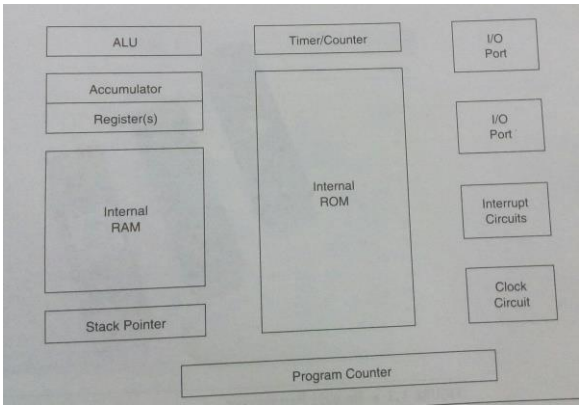


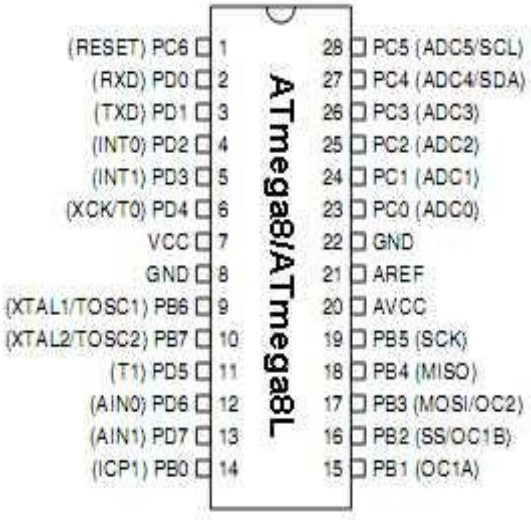
Figure shows Block Diagram of Microcontroller

MICOCONTROLLER (ATMEGA8L)

The ATmega8 is a low-power CMOS 8-bit microcontroller based on the AVR RISC architecture.By executing powerful instructions in a single clock cycle, the ATmega8 achieves throughputsapproaching 1 MIPS per MHz, allowing the system designer to optimize power consumption ver-sus processing speed. The AVR core combines a rich instruction set with 32 general purpose working registers. All the 32 registers are directly connected to the Arithmetic Logic Unit (ALU), allowing two independent registers to be accessed in one single instruction executed in one clock cycle. The resulting architecture is more code efficient while achieving throughputs up to ten times faster than conventional CISC microcontrollers .The ATmega8 provides the following features: 8K bytes of In-System Programmable Flash with Read-While-Write

ISSN: 2277-9655
Scientific Journal Impact Factor: 3.449
(ISRA), Impact Factor: 2.114

capabilities, 512 bytes of EEPROM, 1K byte of SRAM, 23 general purpose I/O lines, 32 general purpose working registers, three flexible Timer/Counters with compare modes, internal and external interrupts, a serial programmable USART, a byte oriented Two-wire Serial Interface, a 6-channel ADC (eight channels in TQFP and QFN/MLF packages) with 10-bit accuracy, a programmable Watchdog Timer with Internal Oscillator, an SPI serial port,and five software selectable power saving modes. The Idle mode stops the CPU while allowing the SRAM, Timer/Counters, SPI port, and interrupt system to continue functioning. The Power-down mode saves the register contents but freezes the Oscillator, disabling all other chip functions until the next Interrupt or Hardware Reset. In Power-save mode, the asynchronous timer continues to run, allowing the user to maintain a timer base while the rest of the device is sleeping. The ADC Noise Reduction mode stops the CPU and all I/O modules except asynchronous timer and ADC, to minimize switching noise during ADC conversions. In Standby mode, the crystal/resonator Oscillator is running while the rest of the device is sleeping. This allows very fast start-up combined with low-power consumption.



PROJECT OBJECTIVE

- Maintaining speed of motor constant at any load condition.
- Analysis of motor at different loading condition

1. Theoretically.
2. Practically.

WORK RELATED TO DC MOTOR

The rectified voltage consists of chopper which is driven by an microcontroller unit. The control of voltage motor is measured with analog to digital converter. The microprocessor display the actual sped of the motor, it compares the actual speed with the reference speed and generates the control signal which triggers the unit. The HB bridge power MOSFET amplifier drives this unit which in turn supplies the voltage of an PWM dc motor.

METHODOLOGY

The goal of using the speed controlling of dc motor is to achieve the system at any loading condition with constant speed . The speed will not change wth the varying load . The microcontroller based closed loop dc motor speed controller enables unskilled operator to use it which controls the speed of dc motor by using PWM and dc chopper. The PWM output may changes from 0% to 100%. Suppose if the load decreases but still the speed of the motor will remains the same as a result the output of the controller unit will be achieved by the desired level of voltage . When the load goes beyond its limit then the motor will not run at high speed instead of it runs at owns speed . The output voltage will send the message OVERLOAD on LCD so the condition can be understood by the user and thereby operator will reduced the load of the motor.

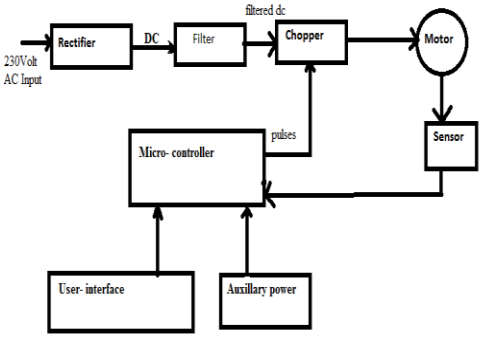


Figure1. showing block diagram of an proposed system

System Modelling

The chopper is mainly used for controlling the motor. The output is mainly given by the sensor which senses the speed This output is given to the microcontroller by the sensor which determines the voltage output at an desired speed.

Description

The PWM circuit mainly uses ATmega8L timer. By controlling the values we can control the duty cycle. The motor mainly runs at constant speed by the use of

ISSN: 2277-9655
Scientific Journal Impact Factor: 3.449
(ISRA), Impact Factor: 2.114

an sensor (tachogenerator) Suppose if the load increases or decreases the motor will run at an constant speed. There will be no increase or decrease of the voltage. By increasing the duty cycle of the microcontroller. The desired speed can be achieved by the microcontroller. If the duty cycle fails to run at the same speed it will show an message OVERLOAD in the LCD screen so the operator will reduced the load.

Pulse Width Modulation

PWM provides an medium amount of an electric power. PWM is the latest technique in which the microcontroller ATmega8L has been used and has 3timer/counter for different speed of dc motor we had used timer/counter 2 for the PWM generation. Two different modes have been used ie, operation inverted and operation non inverter. Here non inverter operation have been used.

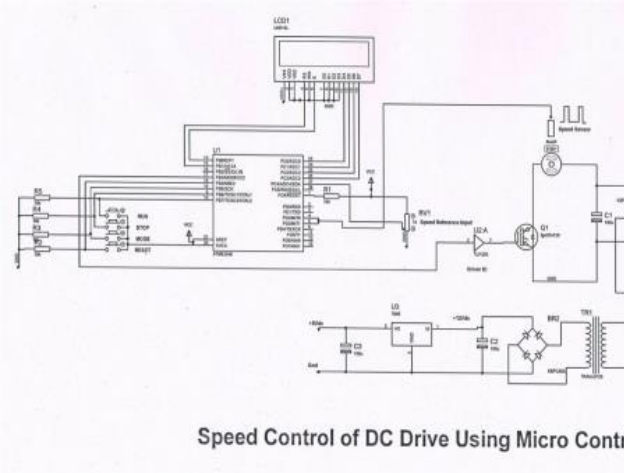


Figure2. shows an schematic view of an proposed system

Tachogenerator

Tachogenerator is defined as those sensor's which are used for sensing the speed. Speed is directly proportional to the voltage for dc motor. Potentiometer is being connected at the terminal end of the tachogenerator along with the motor. By using tachogenerator we get a drop in the voltage which is equal to the speed of the motor so if the motor runs slowly values will be smaller and if the motor runs at high speed values will be higher.

Advantages

1. It can be easily controllable.
2. Reliability.
3. High Performance.
4. Improved accuracy.
5. Fast dynamic response.
6. Reduced effects of an load disturbances.
7. System non linearities.

Analog to Digital converter

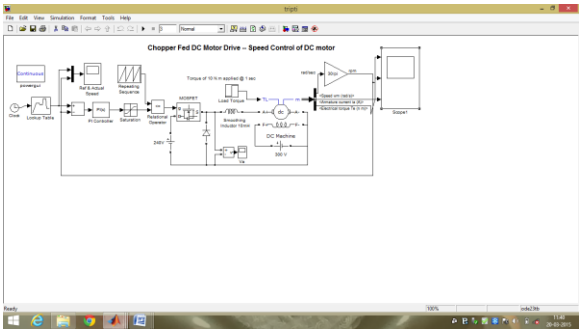
N-bit resolution has been present in ADC where n=8,10,12,16 or it can be even of 24 bits. The smaller the step size greater will be the resolution. It has six multiplexed channels which is registered type ADC of the ATmega8L which has an 10 bit successor.

SIMULINK MODEL OF CHOPPER FED DC DRIVE

Rating of the elements used in above simulation:

DC input voltage =240V
DC machine rating =5HP, 240V, 1750 rpm
Applied field voltage =300V

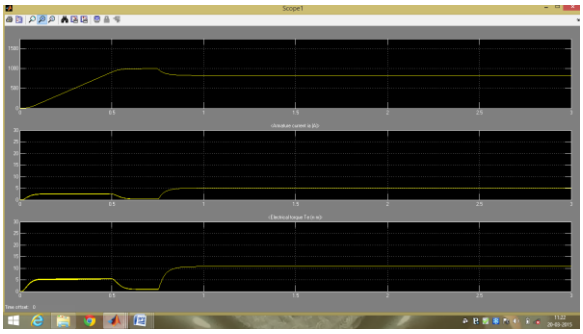
Torque of 10 N-m is applied @ 1sec , L= 10mH



After simulation of the above model we are getting a graph of armature speed , armature current, electrical torque and armature voltage with respect to time

RESULT AND DISCUSSION

The simulation of speed control of DC motor has been successfully controlled by using chopper as a converter. We can also implement it in hardware to observe actual feasibility. Here speed control of DC motor is done for rated and below rated speed. We can also control the speed of DC motor above rated speed and this can be done by field flux control.

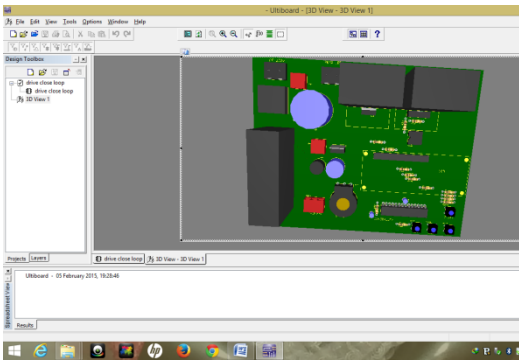


simulation output of a chopper fed DC motor

ISSN: 2277-9655
Scientific Journal Impact Factor: 3.449
(ISRA), Impact Factor: 2.114

By implementing microcontroller the more constant speed will obtained and less tme is required for the settlement of an current , speed and torque .

3D view of an proposed system



REFERENCES

[1] Gopal K. Dubey, "Fundamentals of Electric Drives", Narosa Publishing House New Delhi,1989.

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

[3] Kumara MKSC, Dayananda PRD, Gunatillaka MDPR, Jayawickrama SS, "PC based speed controlling of a dc motor", A final year report University of Moratuwa Illiniaus USA, 2001102.

[4] J Nicolai and T Castagnet , "A Flexible Micro controller Based Chopper Driving a Permanent Magnet DC Motor", The European Power Electronics Application. 1993.

[5] J. Chiasson, Nonlinear Differential-Geometric Techniques for Control of a Series DC Motor, IEEE Transactions on Control Systems Technology. vol 2, p. 35-42,1994.

[6] A Khoei Kh. Hadidi, "Microprocessor Based Closed-Loop Speed Control System for DC Motor Using Power MOSFET", 3rd IEEE international conference on Electronics, Circuits and Systems(1996) vol.2, pp.1247-1250.

[7] Peter Spasov, "Microcontroller Technology: The 68HC11" Prentice Hall, 5th edition, 2004