ISSN 2278-3091

International Journal of Advanced Trends in Computer Science and Engineering, Vol.5 , No.1, Pages : 124 -127 (2016)
Special Issue of ICACEC 2016 - Held during 23-24 January, 2016 in Institute of Aeronautical Engineering, Quthbullapur, Telangana-43, India

Microcontroller Based Speed Control of a DC Motor Using PWM Technique

V Srikanth, G Prasad, B C Chakrapani, Samule Jaswanth, V Ravi Shankar, P Sridhar
Department of Electrical and Electronics Engineering
Institute of Aeronautical Engineering, Hyderabad
srivana324@gmail.com

Abstract*:* The aim of development of this project is towards providing efficient and simple method for control speed of DC motor using pulse width modulation technique. The modulation of pulse width is obtained using pulse width generator in ATmega16 Microcontroller. Pulse-width modulation (PWM), or pulse-duration modulation (PDM), is a technique used to encode a message into a pulsing signal. It is a type of modulation. Although, this modulation technique can be used to encode information for transmission, its main use is to allow the control of the power supplied to electrical devices, especially to inertial loads such as DC motors. There are several methods for controlling the speed of DC motors. One simple method is to use potentiometer to change the pulse width which inherently controls the DC motor speed. while, atmega16 microcontroller is fast and efficient which has inbuilt 8 bit ADC which converts analog change in potentiometer to digital pulse, which in turn is exposed to pulse width generator, which generates pulses and these pulses are connected to DC motor using L293D Driver IC.

Key words: Micro controller, L293D motor drive, Pulse width modulation technique.

1. INTRODUCTION

Speed control of dc motor could be achieved using mechanical or electrical techniques. In the past, speed controls of dc drives are mostly mechanical and requiring large size hardware to implement. The development has launched these drives back to a position of formidable relevance, which were hitherto predicted to give way to ac drives. Fractional horsepower dc drives are widely employed as servo means for positioning and tracking. Controlled rectifiers provide a variable dc voltage from a fixed dc voltage. Due to their ability to supply a continuously variable dc voltage, controlled rectifier and dc choppers made a revolution in modern industrial equipment and variable speed drives. Adjustable speed drives may be operated over a wide range by controlling armature or field excitation. Transistor and thyristor along with various analog digital chips used in firing or controlling circuits have made dc driver more accessible for control in innumerable areas of applications. Recent developments in the area of semiconductor technology have made smaller, faster microprocessors and microcontrollers available at reduced cost. The potential use of microprocessors to control some or all electronic functions justifies their use. The main objective of this work is to become familiar with the design and implementation of both software and hardware of a microcontroller based open loop speed control of DC motor and speed of DC motor is controlled by pulse width modulation which is generated by microcontroller by using analog to digital converter. The purpose of a motor speed controller is to take a signal representing the required speed, and to drive a motor at that speed. Speed control means intentional change of the drive speed to a value required for performing the specific work process. Through this concept we can control speed of a motor on its running condition. Speed control is a different concept from speed regulation where there is natural change in speed due change in load on the shaft. Speed control is either done manually by the operator or by means of some automatic control device and by some important printing presses, textile mills, rolling mills & accelerators. Through this work we can bring motor speed in any rpm with the microcontroller by setting it using keyword.

1.1 Description of research work

The electric drive systems used in many industrial applications require higher performance, reliability, variable speed due to its ease of controllability. The speed control of DC motor is very crucial in applications where precision and protection are of essence. Purpose of a motor speed controller is to take a signal representing the required speed and to drive a motor at that speed. Microcontrollers can provide easy control of DC motor. Microcontroller based speed control system consist of electronic component, microcontroller and the LCD. In this project, implementation of the ATmega16 microcontroller for speed control of DC motor fed by a L293D Driver Circuit has been investigated. The L293D Driver is driven by a high frequency PWM signal. Controlling the PWM duty cycle is equivalent to controlling the motor terminal voltage, which in turn adjusts directly the motor speed. This work is a practical one and high feasibility according to economic point of view and accuracy. In this work, development of hardware and software of the open loop dc motor speed control system have been explained and illustrated. The desired objective is to achieve a system with the constant speed at any load condition. That means motor will run at a fixed speed instead of varying with amount of load.

2.1 Pulse Width Modulation Technique

Pulse-width modulation (PWM) or pulse-duration modulation (PDM) is a technique used to encode message into a pulsing signal. It is a type of modulation. Although this modulation technique can be used to encode information for transmission, its main use is to allow the control of the power supplied to electrical devices, especially to inertial loads such

ISSN 2278-3091

International Journal of Advanced Trends in Computer Science and Engineering, Vol.5 , No.1, Pages : 124 -127 (2016)
Special Issue of ICACEC 2016 - Held during 23-24 January, 2016 in Institute of Aeronautical Engineering, Quthbullapur, Telangana-43, India

as motors. In addition, PWM is one of the two principal algorithms used photovoltaic solar battery chargers, the other being MPPT.

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 rate. The longer the switch is on compared to the off periods, the higher the total power supplied to the load.

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 rate. The longer the switch is on compared to the off periods, the higher the total power supplied to the load.

The PWM switching frequency has to be much higher than what would affect the load (the device that uses the power), which is to say that the resultant waveform perceived by the load must be as smooth as possible. Typically switching has to be done several times a minute in an electric stove, 120 Hz in a lamp dimmer, from few kilohertz (kHz) to tens of kHz for a motor drive and well into the tens or hundreds of kHz in audio amplifiers and computer power supplies.

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.

3.1 ATmega16 Microcontroller

The ATmega16 is a low-power CMOS 8-bit microcontroller based on the AVR enhanced RISC architecture. By executing powerful instructions in a single clock cycle, the ATmega16 achieves throughputs approaching 1 MIPS per MHz allowing the system designed to optimize power consumption versus 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 CSIC microcontrollers.

3.1 Features of ATmega16:

• High-performance, Low-power Atmel® AVR® 8-bit Microcontroller

• Advanced RISC Architecture

– 131 Powerful Instructions – Most Single-clock Cycle Execution
– 32 x 8 General Purpose Working Registers
– Fully Static Operation
– Up to 16 MIPS Throughput at 16 MHz
– On-chip 2-cycle Multiplier

• High Endurance Non-volatile Memory segments

– 16 Kbytes of In-System Self-programmable Flash program memory
– 512 Bytes EEPROM
– 1 Kbyte Internal SRAM
– Write/Erase Cycles: 10,000 Flash/100,000 EEPROM
– Data retention: 20 years at 85°C/100 years at 25°C
– Optional Boot Code Section with Independent Lock Bits

• Peripheral Features

– Two 8-bit Timer/Counters with Separate Prescalers and Compare Modes
– One 16-bit Timer/Counter with Separate Prescaler, Compare Mode.
– Real Time Counter with Separate Oscillator
– Four PWM Channels
– 8-channel, 10-bit ADC
– Byte-oriented Two-wire Serial Interface
– Programmable Serial USART
– Master/Slave SPI Serial Interface
– Programmable Watchdog Timer with Separate On-chip Analog Comparator

• Special Microcontroller Features
– Power-on Reset and Programmable Brown-out detection
– Internal Calibrated RC Oscillator
• External and Internal Interrupt Sources
– Six Sleep Modes: Idle, ADC Noise Reduction, Power-save, Power-down. Operating Voltages 4.5V - 5.5V for ATmega16
• Speed Grades 0 - 16 MHz for ATmega16

• Power Consumption @ 1 MHz, 3V, and 25°C for ATmega16

– Active: 1.1 mA
– Idle Mode: 0.35 mA

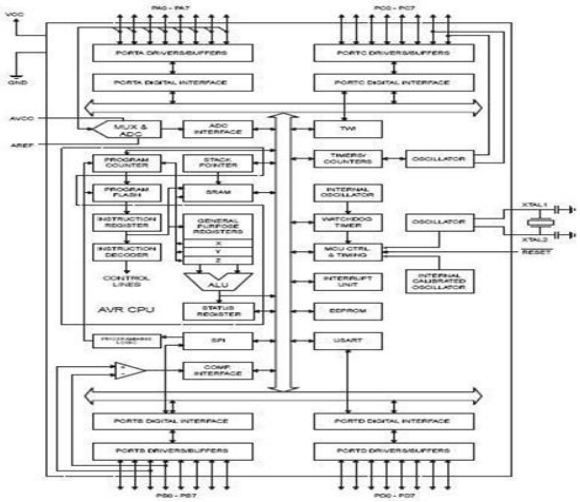

Figure 1. Architecture of ATmega16

ISSN 2278-3091

International Journal of Advanced Trends in Computer Science and Engineering, Vol.5 , No.1, Pages : 124 -127 (2016)
Special Issue of ICACEC 2016 - Held during 23-24 January, 2016 in Institute of Aeronautical Engineering, Quthbullapur, Telangana-43, India

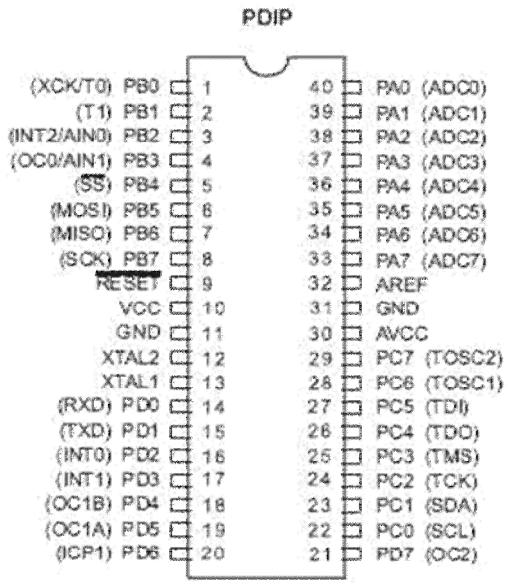

Figure 2. PIN diagram of ATmega16 Micro controller

3.2 L293D MOTOR DRIVER:

L293D is a dual H-bridge motor driver integrated circuit (IC). Motor drivers act as current amplifiers since they take a low-current control signal and provide a higher current signal. This higher current signal is used to drive the motors. An H bridge is an electronic circuit that enables a voltage to be applied across a load in either direction. These circuits are often used in robotics and other Applications to allow DC motors to run forwards and backwards. Most DC-to-AC converters (power inverters), most AC/AC converters, the DC-to-DC push–pull converter, most motor controllers, and many other kinds of power electronics use H bridges. In particular, a bipolar stepper motor is almost invariably driven by a motor controller containing Two H Bridges.

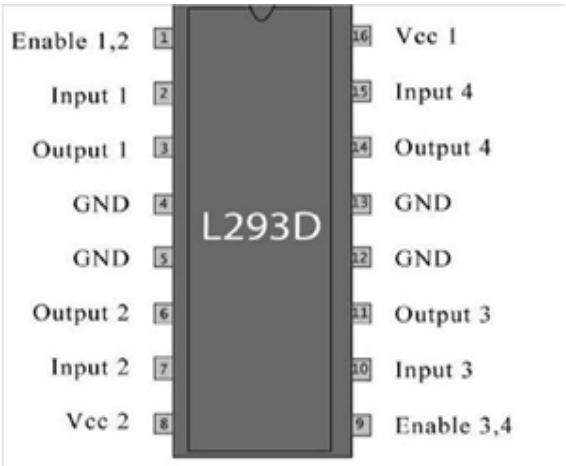

Figure 3: pin diagram of 293D driver

4.1 SOFTWARE DEVELOPMENT

The software development is implemented using AVR studio Integrated development environment for programming the ATMEGA16 Microcontroller in embedded 'C' programming and thereby, Proteus hardware emulator software is used to qualify the programmed microcontroller.

4.1.1 AVR STUDIO:

ATmel AVR Studio 4 is the Integrated Development Environment (IDE) for developing and debugging embedded Atmel AVR applications. The AVR Studio 4 IDE gives you a seamless and easy-to-use environment to write, build, and debug your C/C++ and assembler code.

The AVR Software Framework is a collection of production-ready source code, written and optimized by experts and tested in hundreds of production designs. Using these peripheral drivers, communication stacks and application-specific libraries is the quick and effortless way to complete a project. Software Framework works across all 32bit AVR UC3 and 8-bit AVR XMEGA devices and works with both GNU and IAR C compilers.

The AVR Software Framework is a collection of production-ready source code, written and optimized by experts and tested in hundreds of production designs. Using these peripheral drivers, communication stacks and application-specific libraries is the quick and effortless way to complete a project. Starting a new project is easy. In AVR Studio 4, the New Project wizard sets up all the compiler and linker settings, the below snapshot shows the AVR studio IDE.

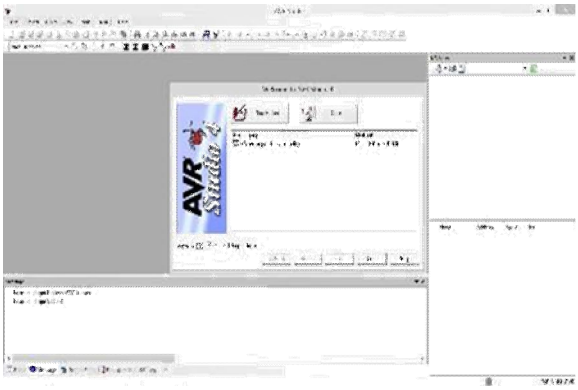

Figure 5 : program written in AVR studio

4.1.2 PROTEUS SOFTWARE EMULATOR:

Proteus is a tool that allows authoring, modification and execution of Proteus guidelines. Proteus is a guideline model for creation of guidelines and guideline software systems. The Proteus guidelines are composed of modular entities called knowledge components (KCs), with each having the capability of possessing its own interfering mechanism. The KCs may be reused for different problems in different guidelines. The KCs can also execute in computer software that has the ability to interpret them to provide decision support to healthcare professionals. Protean is a software environment under development in which Proteus

ISSN 2278-3091
International Journal of Advanced Trends in Computer Science and Engineering, Vol.5 , No.1, Pages : 124 -127 (2016)
Special Issue of ICACEC 2016 - Held during 23-24 January, 2016 in Institute of Aeronautical Engineering, Quthbullapur, Telangana-43, India

guidelines and KCs may be authored/edited and executed.

Proteus is best simulation software for various designs with microcontroller. It is mainly popular because of availability of almost all microcontrollers in it. So it is a handy tool to test programs and embedded designs for electronics hobbyist. User can simulate y programming of microcontroller in Proteus Simulation Software.

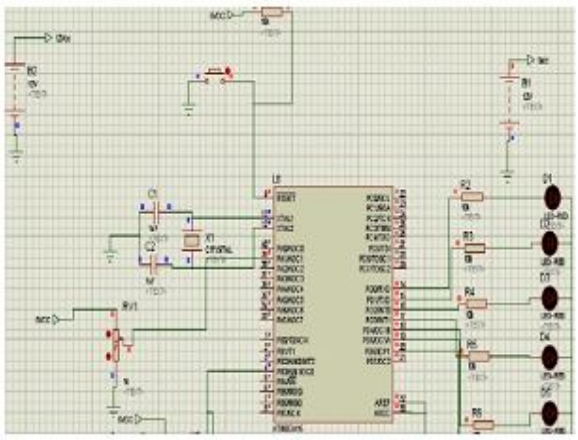

Figure 6**:** Hardware Simulation Model

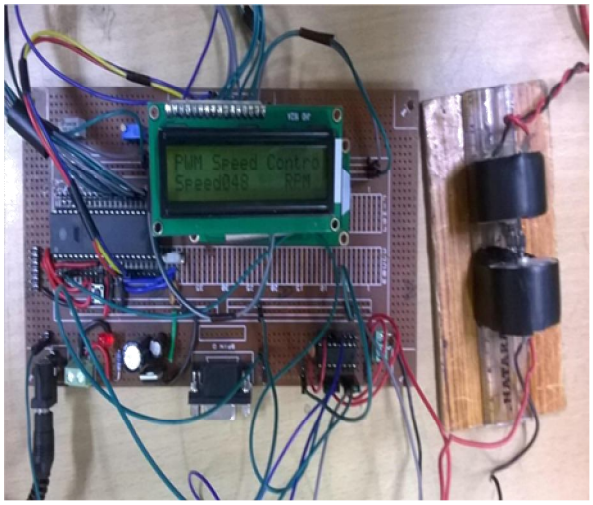

Figure 7. Snapshot of PCB board

RESULT

The circuit is based on PWM technique. ATmega-16's timer portion has this special feature. By adjusting register values (OCR, TCCR etc) duty cycles can be controlled. When motor run at 70% of duty cycle, the DC generator gives a Voltage corresponds to that speed. Now if any load occurs, desired speed will be decreased. Hence, the voltage drop will be less. This voltage occurred by rotating the potentiometer is fed into the ADC of microcontroller and it will start increasing its duty cycle until it reaches the desired speed.

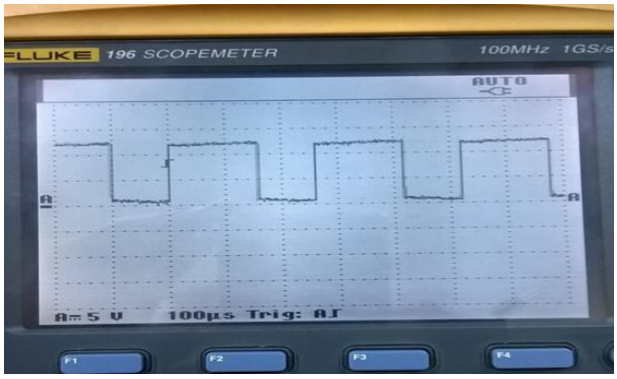

Figure 8. Snap Shot of Pulse Width Modulation of Oscilloscope

Conclusions

The microcontroller based open-loop automatic speed control of dc motor using PWM Technique has been introduced. Controlling a permanent magnet DC motor with speed measuring through DC generator will be implemented using an ATmega16 microcontroller. The system will be made user friendly so that anybody can operate the system without any trouble. LCD display will used to show the speed of the system. Knowing the condition the user can change the amount of load if necessary. The future advancements can be made to system by introducing GSM technique to the system and maintain a feedback loop if overload occurs. So, presently the PWM based controlling of DC motor speed is implemented.

Acknowledgements

The authors would like to acknowledge the management, Director, Principal and faculty members of Electrical and Electronics Engineering for their continuous support in the completion of this paper.

References

[1]. Atmel AVR Microcontroller Primer
[2]. Electrical machines by B L THERAJA.
[3]. Atul Kumar Dewagan ,Nibedita Chakraboorthy, Sashi Shukal,Vinod Yadu, "PWM Based Automatic Closed Loop Speed Control of DC Motor" , issue in International Journal of Engineering Trends and Technology, Volume3, Issue 22, 2012.
[4]. Pulse width modulator module (PWMM), ATmega16L data sheet.
[5]. ADC devices, ATmega16L data sheet.
[6]. LCD interfacing, the microcontroller and embedded systems by Muhammad Ali Mazidi, Janice Gillispie Mazidi, Rolin D. Mckinlay.