Jeetender Singh Chauhan, Sunil Semwal / International Journal of Engineering Research and Applications (IJERA) ISSN: 2248-9622 www.ijera.com
Vol. 3, Issue 1, January -February 2013, pp.778-783

# Microcontroller Based Speed Control of DC Geared Motor Through RS-232 Interface With PC

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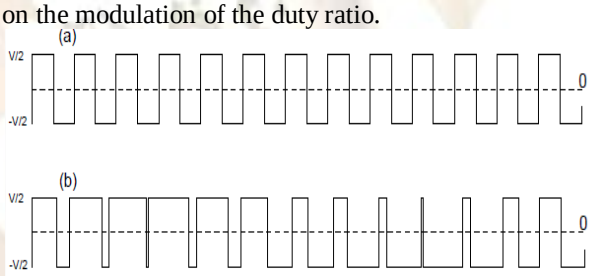
**Abstract: The speed control of DC motor is very crucial in applications where precision and protection are of essence. Purpose of a motor speed controller is to take a signal representing the required speed and to drive a motor at that speed. In this paper PWM based speed control of DC motor through RS232 with PC goal of this as Role of electrical drives is a major concern in industrial automation. Industrial applications use dc motors because the speed-torque relationship can be varied to almost any useful form for both dc motor and regeneration applications in either direction of rotation. DC motors feature a speed, which can be controlled smoothly down to zero, immediately followed by acceleration in the opposite direction without power circuit switching. Having intelligence PC available to control operation of speed of motor which can increase productivity in broad range of industry. Personal computers or Laptops are working on Register Level while our controller is working on TTL so we have to use a level shifter that is MAX232 IC which can change the platform for serial communication. This software provide variable baud rate for operation, and connect PC to MAX232 using serial cable.**

**Keywords:** DC Motor, RS232,MAX 232, PC,USART

## I. 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 predicted to give way to ac drives. Some important applications are rolling mills, paper mills mine winders, hoists, machine tools, traction, printing presses, textile mills, excavators and cranes. This paper provides a system that can utilized to use DC motor for various applications. We can utilize the DC Motor for various applications by controlling the speed and orientation according to the field of interest. Pulse Width Modulation (PWM) is the technique of utilizing switching devices to produce the effect of a continuously varying analog signal. This PWM conversion generally has very high electrical efficiency and can be used in controlling either a three-phase synchronous motor or a three-phase induction motor .It is desirable to create three perfectly sinusoidal current waveforms in the motor windings, with relative phase displacements of 120°. The production of sine wave power using a linear amplifier system would have low efficiency, maximum of 64%. Efficiency can be increase up to 95% if instead of the linear circuitry, fast electronic switching devices are used, depending on the properties of the semiconductor power switch.The result is a load current waveform that depends mainly on the modulation of the duty ratio.

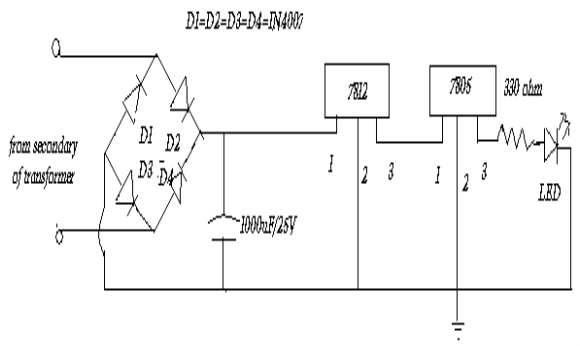



**Fig(1.0):Wave form at different duty cycles**

## II. HARDWARE DEVELOPMENT

BLOCK DIAGRAM OF THE PROPOSED SYSTEM IS SHOWN BELOW:

***(1)Power supply modules***-This module is basically designed to achieved 5V,500mA.This consists of a transformer which is used to step down the AC voltage ,IN4007 diodes used to form a bridge rectifier to convert AC to DC , capacitor 1000uF which used as a filter circuit ,7805 regulator to obtain a 5V at the output of the regulator ,330 ohm resistance, LED as indicator.




**Fig(2.0): diagram of supply section**

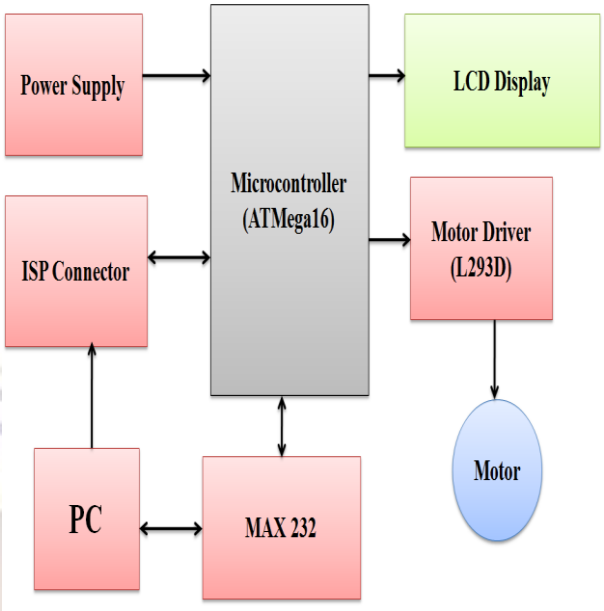
***(2)Embedded microcontroller***-There is a whole wide range of microcontroller available in the market. But this particular project is developed using AVR series of microcontroller (ATMEGA16) because of its inbuilt ADC port and its variable frequency.ATmega16 is a low-power CMOS 8-bit microcontroller based on the AVR 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. Further it also minimizes the cost of this personal area network.

***(3)*USB to serial cable**-To interfaces the coordinator node with the other nodes.

***(4)DB9***- It is 9 pin male / female connector. In DB9 9 represent total number of pins and D represents the two parallel rows of pins that are in the shape of D alphabet.

***(5)Display module***- The LCD(liquid crystal display) unit receives character codes (8 bits per character) from a microprocessor or microcomputer, latches the codes to its display data RAM (80-byte) DD RAM for storing 80 characters, transforms each character code into a 5'7 dot-matrix character pattern, and displays the characters on its LCD screen.

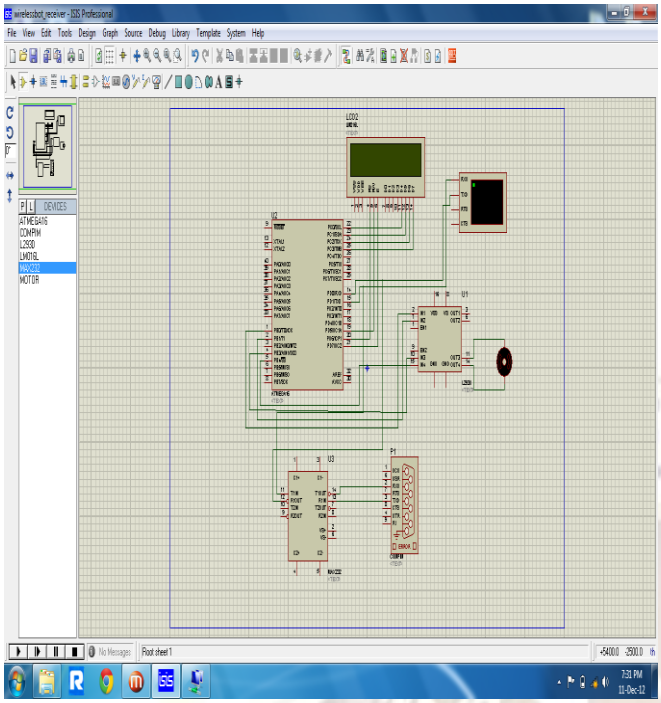
We are 16*2 LCD 's which have 16 columns and 2 rows with 16 hardware pins connected as pin 1,3and 16 are connected to ground , pin 2 and 15 are connected to +5v pin 3 ,4,5 are RS ,RW and enable respectively enable pin is always low . data pins of LCD are 11,12,13,14 which are used for 4 bit parallel communication .




**Fig( 2.1): Block Diagram of system**

**(6)MAX *232(level converter)*-**MAX232 is a dual driver/receiver IC that includes a capacitive voltage generator to supply EIA-232 voltage levels from a single 5-V supply [2]. Each receiver converts EIA-232 inputs to 5-V TTL/CMOS levels. These receivers have a typical threshold of 1.3 V and a typical hysteresis of 0.5 V, and can accept ±30-V inputs. Each driver converts TTL/CMOS input levels into EIA-232 levels. This can be made to work with the help of a few capacitors attached to it.

**(7)L293D(*motor driver IC*)**-This IC is high voltage high current four channel driver designed to accept DTL or TTL logic.This can provide 600mA output current capability per channel and providing 1.2 peak output current(non repetitive) per channel and also have internal over temprature protection . It consists of a half H bridge to provide high current in order to drive motors.



**Fig(2.2): Simulation Diagram of system**

## III. Software Development

Microcontroller, when it is used to operate as a wireless network involves following steps:

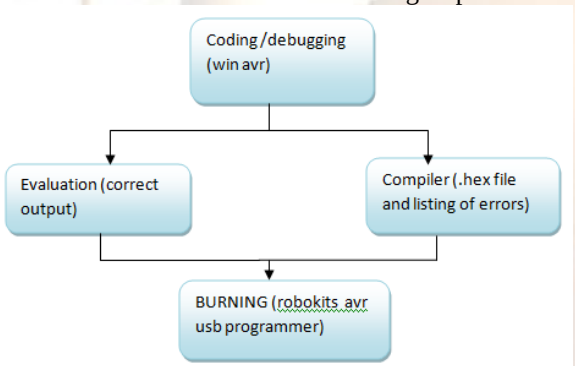



**Fig (3.0): Steps for software development**

***(a) Coding / Debugging***- Coding or debugging is one in a high-level language (such as c or java). Compiler for a high level language helps to reduce production time. To program the microcontrollers WinAVR [2] was used using C language. The source code has been commented to facilitate any occasional future improvement and maintenance. WinAVR is a suite of executable, open source software development tools for the Atmel AVR series of RISC microprocessors hosted on the Windows platform. It includes the GNU GCC compiler for C and C++. WinAVR contains all the tools for developing on the AVR. This includes AVR-gcc (compiler), AVR-gdb (debugger) etc.

***(b) Compiling***- After compiling the program, it is converted to machine level language in the form of o's ans1's.This file is called as the Hex file and is saved with the extension (.Hex). The compiler also generates errors in the program which should be removed for proper execution of the program.

***(c) Burning***- Burning the machine language (hex) file into the microcontroller's program memory is achieved with a dedicated programmer, which attaches to a PC's peripheral. PC's serial port has been used for the purpose. for this purpose Ponyprog programmer was used to burn the machine language file into the microcontroller's program memory. Pony prog is serial device programmer software with a user-friendly GUI framework available for Windows95/98/ME/NT/2000/XP and Intel Linux. Its purpose is reading and writing every serial device. It supports I²C Bus, Micro wire, SPI EEPROM, and the Atmel AVR and Microchip PIC microcontroller. The microcontrollers were programmed in approximately two seconds with a high speed-programming mode. The program memory, which is of Flash type, has, just like the EEPROM, a limited lifespan. On AVR microcontroller family it may be reprogrammed up to a thousand times without any risk of data corruption Atmega16 Programmer (ISP) which is used to burn the program into AVR microcontrollers.

***(d) Evaluation***-If the system performs as desired by the user and performs all the tasks efficiently and effectively the software development phase is over and the project is ready to be installed in any of the industrial sites as a personal area network. If not, the entire process is repeated again to rectify the errors. One of the difficulties of programming microcontrollers is the limited amount of resources the programmer has to deal with. In PCs resources such as RAM and processing speed are basically limitless when compared to microcontrollers. In contrast to a PC, the code on microcontrollers should be as low on resources as possible, but being cost effective and power efficient makes it a better option. In the programming of the proposed system is used the following .c and .h file

***(1)lcd.c*** -This c file contains the code for control of functionality of the attached LCD module. The code controls the initialization of the LCD, data writing on the LCD, and also the movement, characteristics and location of the cursor. It offers the facility to write data on the LCD character-by-character or string-wise. The command set used in the software is based on the command set used in the LCD based on Hitachi HD44780 ICs. This file contain INitlcd( ), remove ( ), display ( ) and displayint ( ).

**(i) to initialize the LCD:**

```
Void INitlcd( )
{
//This function Initializes the lcd module
```

must be called before calling lcd related functions
Arguments:
style = LS_BLINK,LS_ULINE(can be "OR"ed for combination)
LS_BLINK :The cursor is blinking type
LS_ULINE :Cursor is "underline" type else "block" type}

**(ii) to display strings to LCD :**

Void display( const char *data)
{
//This function Writes a given string to lcd at the current cursor location.
Arguments:
msg: a null terminated string to print}

***(2) lcd.h-*** This header file contains all the constant variable values and names of the subroutines used by various files used in the software. It clearly indicates which variable can be used as a global variable and which of the subroutines can be used across the software files.

***(3) Usart_lib.c*** - This file contains the code for controlling the USART of ATMEGA'S. This is contain three major functions USARTInit ( ), USARTReadChar ( ) and USARTWriteChar ( ).

*Initialization of USART:*
This function will initialize the USART.

```
void USARTInit(uint16_t ubrr_value)
{
UBRR= ubrr_value;  //Set Baud rate
UCSRC=(1<<URSEL)|(3<<UCSZ0);//  Set Frame Format
UCSRB=(1<<RXEN)|(1<<TXEN);//  //Enable The receiver and transmitter
}
```

*Reading From The USART :*
This function will read data from the USART.

```
char USARTReadChar()
{
   while(!(UCSRA & (1<<RXC))) //Wait until a data is available
   {
      //Do nothing
   }
   return UDR;  //Now USART has got data from host and is available is buffer
   }
   Writing to USART:
   void USARTWriteChar(char data)
   {
   while(!(UCSRA & (1<<UDRE)))  //Wait until the transmitter is ready
    {
      //Do nothing
    }
   UDR=data;  //Now write the data to USART buffer
   }
```

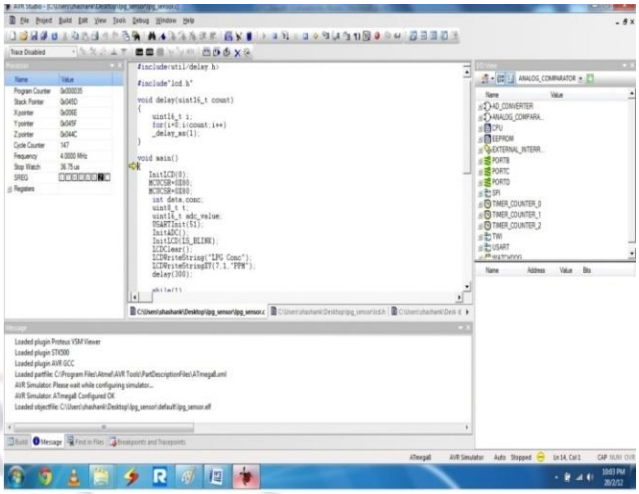


**Fig (3.1): snapshot C coding for proposed system using of AVRstudio4**

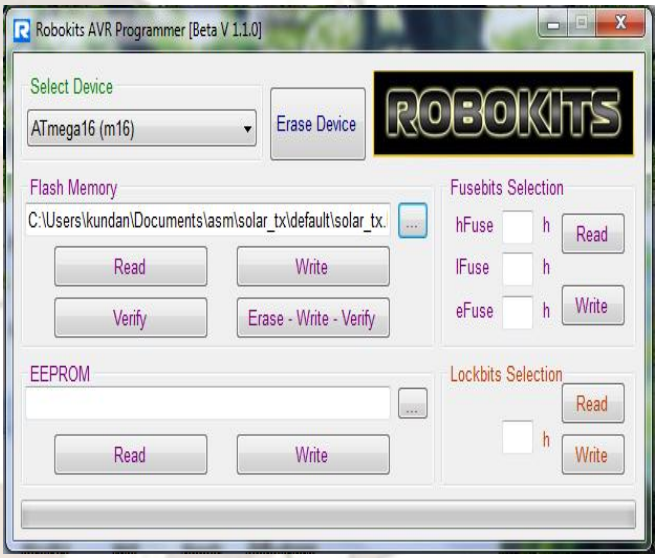
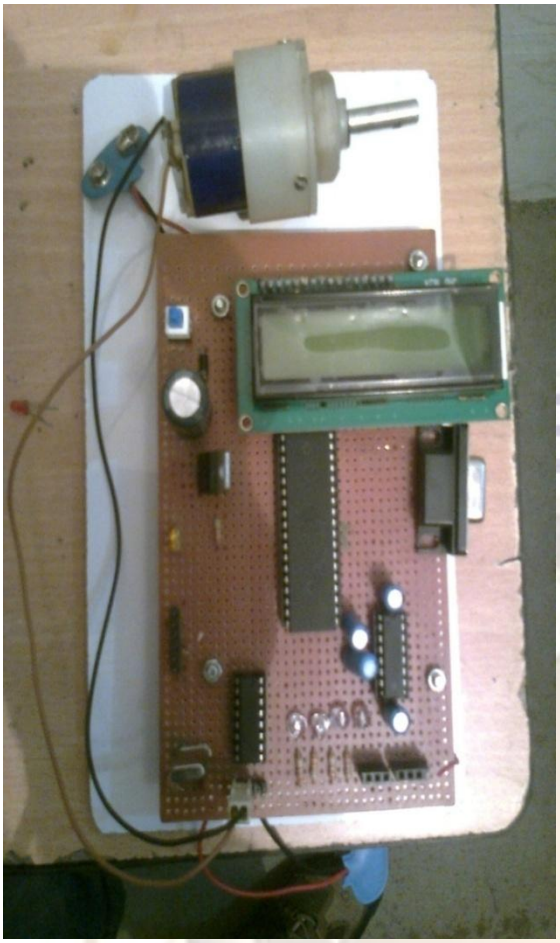



**Fig (3.2): view of hardware AVR Programmer (ISP) by Robokits**


**Fig (3.3): snapshot of robokits AVR programmer window to erase, write and verify .h file generated by AVRstudio4 to target**



**Fig(3.4): View of Hardware module**

**Fig(3.5): View of Complete System**

**Conclusion:** The designing of a sustainable system to control the speed and orientation of a geared DC Motor was successfully implemented in this paper.DC motors have speed control capabilities which means that speed, torque and even direction of rotation can be changed at anytime to meet new condition.The hardware of the proposed system and interfacing with computer using RS232 serial communication port. The project can be divided into two element which hardware and software. The developed system we can develop the GUI to monitor and control the speed of DC motor.The paper provides a platform for further advancement in the field of industrial use of DC geared motors.

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## AKNOWLEDGEMENT

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