



Microcontroller (TMS 320 F 28027) Based Speed Control of DC Motor Using PWM Technique

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ABSTRACT

In the era of automation use of DC motor increased day by day. Controlling of DC motors can be done through electrically or mechanically. There is need of intelligent devices for controlling DC motor. The system proposed in this paper is speed control of DC motor based on TMS microcontroller using PWM technique. PWM signal is generated from analog circuit, digital IC, microcomputer and microcontroller. Usually PWM signal is generated from microcontroller (TMS 320 F 28027) because PWM obtained from digital IC, analog or microcomputer contains harmonics. For speed control of DC motor flux and armature control method cannot provide required range of speed. The motor is operated in four quadrants; clockwise, counter clockwise, increasing and decreasing speed. PWM signal generated at 4 duty cycle with value 25%, 50%, 75%, 100% which in turn adjust directly the motor speed.

Keywords: Control of DC Motor, PWM Technique, TMS microcontroller

I. INTRODUCTION

In the era of industrialization and automation necessity of intelligent devices capable for driving and controlling electrical and electromechanical devices is increased. Fast progress in microcontroller has made it possible. In many modern factories all types of electromechanical devices are used and controlled by PWM signal generated from microcontroller. Mainly there are two ways of controlling speed of DC motor; mechanically and electrically. Mechanical method requires large hardware and more cost. But electrical method is small sized. Therefore in this work speed control of DC motor achieved by using electrical method. For increase the productivity of material it is necessary to increase the speed of DC motor. The application of this is used in domestic as well as industrial purpose. To reduce the steady-state error of the rotational speed of motor and to improve the performance of speed regulation of

motor. The use of 8-bit microcontroller requires more and complex hardware where as 16/32 bit microcontroller contains some additional processing functions and advanced PWM techniques therefore use of these microcontrollers is smart choice. In this project we have control the actual speed of DC motor as per our requirement by using TMS (320 F 28027). The main objective of this work is to become familiar with the design and implementation of both software and hardware of microcontroller based speed control of DC motor. The speed of DC motor changed by changing voltage of motor. Firstly by giving supply to TMS. TMS generates pulses, generated pulses are nothing but PWM signal which is given to driver circuit. The main function of driver circuit is to generate 12 V DC pulse. Thus speed of DC motor is controlled by PWM signal. We can control speed of motor in its running condition. The rest of paper is organized as follows-Section II gives Framework of proposed system. Section III gives

working methodology of proposed system, and section IV concludes the paper.

II. SYSTEM ARCHITECTURE

In industrial automation motion control is important. PWM is a method for binary signals generation that is high and low. PWM pulses reaches the full supply voltage and will increase more torque in motor. The system hardware block diagram is shown in figure1. The system mainly includes TMS 320 F 28027 microcontroller, H-bridge driver, DC motor, and power supply. CCP (Capture/Compare/PWM) is inbuilt in TMS which can easily generate PWM signal. These PWM signal applied to enable pin of motor driver IC. The speed and direction of motor changed by DC driver. Two push buttons are used for variation of pulses that is for speed change and another two push buttons are used to control the direction. LED is used for visual indication

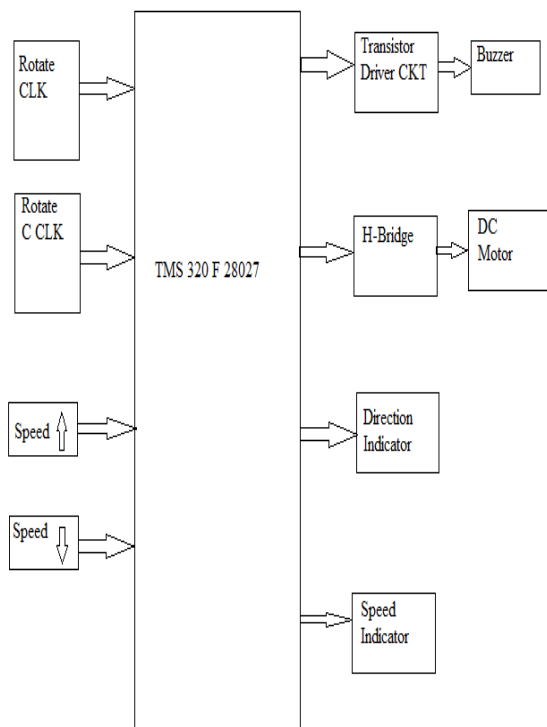


Figure1 .Block Diagram of Speed Control of DC Motor

A. Hardware Specification

1) TMS 320 F 28027

Here we have used TMS 320 F 28027 with Independent 16-Bit Timer in Each Enhanced Pulse Width Modulator (ePWM). The datasheet of micro controller TMS 320 F 28027 provided the working conditions, pin configuration of the microcontroller.

TMS 320 F 28027 is designed to work with Code Composer Studio.

- High Efficiency 32-Bit CPU
- Low cost for both device and system
- Independent 16-Bit Timer in each Enhanced Pulse Width Modulation
- On chip memory
- Code security module
- Three 32-Bit CPU Timer
- Small packaging

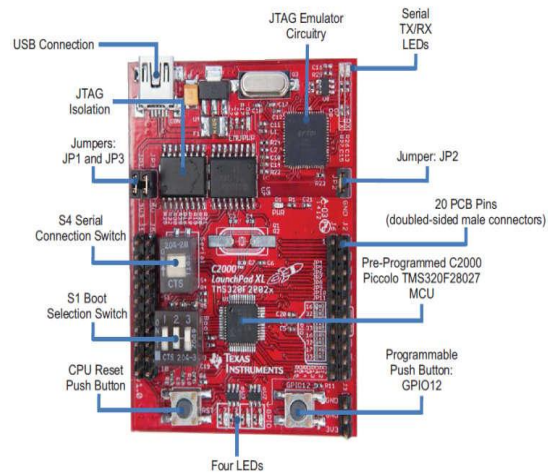


Figure 2 .TMS 320F28027 Board

2) H-Bridge Driver

H-Bridge designed to drive inductive loads such as a DC and switching power transistor. It has 600ma output current capability. Motor driver act as current amplifier. These amplifier current signal is used to drive motor. H-Bridge is an electronic circuit that enables a voltage to be applied across load in either direction. The L293 and L293D are quadruple high-current half-H drivers. It is used in robotics and other applications.

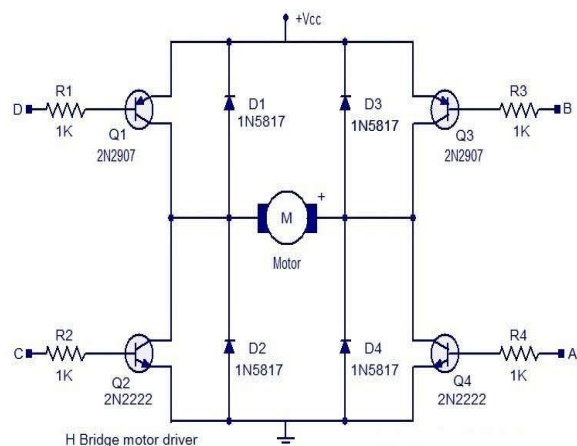


Figure3. H-Bridge Driver

3)12 V DC Motor

12V DC Motor can be used in different types of robotics. DC motor is available with wide range of Torque and RPM. DC Motor used with following specification

- Weight:130 g
- Torque:1.5 kg.cm
- Length:80mm
- Shaft Diameter:6mm

B Software Specification

The software development is implemented using code composer studio integrated development environment for programming the TMS 320 F 28027. Code composer studio IDE gives a seamless and easy to use environment to write, build and debug C/C++ and assembler code.

III. Working Methodology

For TMS 320 F 28027 there is no need to modify the timer for generation of PWM signal TMS has inbuilt CCP (capture /compare/PWM) register which can be generates PWM signal .By using Code Composer Studio (CCS) operational algorithm can be implemented. TMS is code efficient (in C/C++ and Assembly) .The PWM duty cycle for clockwise direction is $PWM\ Duty = (1875 * 2 * App\ Duty\ Cycle)$, The PWM Duty Cycle for anticlockwise direction is $PWM\ Duty = 15000 - (1875 * 2 * App\ Duty\ Cycle)$.

By using App Duty Cycle, initial Duty Cycle can be incremented or decremented .Four switches are used; two for speed & two for direction. Two speed switches are used for incrementing or decrementing of Applied Duty cycle and by using direction switches the direction of device can be changed .These four switches are connected to GPIO pins which are programmable speed of DC motor is complete depends on PWM Duty Cycle. We are using 12 V DC Motor and average DC value delivered to motor can be varied by varying the duty cycle ratio of PWM .The average DC voltage of 0% duty cycle is 0 V, 25% duty cycle is 3 V, 50% duty cycle is 6V, 75% duty cycle is 9V, and for 100% duty cycle 12V.

IV. Conclusion

DC motor is controlled by using series architecture of variable resistor, but it has more power dissipation .DC motor is also controlled by flux and armature control method but it cannot provide required range .Therefore voltage control

method is used in which microcontroller generate the PWM signal. PWM obtained from digital IC, analog or microcomputer contains harmonics. Microcontroller based PWM signal generation consumes less power .Due to flexibility of microcontroller all control algorithms can be implemented in software. Therefore control of DC motor based on TMS microcontroller having high accuracy.

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