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Microcontroller Based Speed Control Scheme of Bldc Motor using Proteus

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Abstract: this paper is proposed to control speed of a dc motor using low cost pic16f877a microcontroller. To accomplish this, pwm technique is used, which is intrinsic under module of pic. A microcontroller based speed control scheme has been developed. The pic16f877a microcontroller has been programmed to vary the duty cycle of motor using mikroc pro simulation software. The complete simulink model has been implemented on proteus design suit. Investigational setup has been developed for the recommended scheme. Trial and simulation results are compared.
Keywords: bldc motor, pwm, proteus vsm, microcontroller

I. INTRODUCTION

Electric motors possess an integral part of both the industrial and the domestic sectors. Motors used in plenty are mostly brushed DC motors which suffer from low efficiency and high maintenance, respectively. Brushless Direct Current (BLDC) motor has gained immense popularity in recent era due to its ease in control, less maintenance due to the absence of brush-commutator arrangement and higher efficiency. They also have high power density especially due to the employment of high energy density permanent magnets used in the rotor.

In this paper, an attempt has been made for designing a low cost microcontroller based 3-phase trapezoidal back-emf Permanent Magnet BLDC motor drive. In order to design a BLDC drive, Proteus VSM simulation software has been used as the primary simulation platform. This allow microcontroller programs to be implemented directly to the simulation block, i.e. the program logic can be built using any PIC microcontroller assembler and the program file (hex code) generated after building the logic can be uploaded directly to the microcontroller model available in Proteus. Run time modification of any input data is also allowed in this software. PIC16F877A microcontroller has been chosen to develop the control algorithm for driving 3 phase BLDC motors using mostly the modules like 14-bit Power Control PWM Module, Motion Feedback Module and High-Speed 200 Ksps 10-bit ADC module.

The entire drive circuit including the motor model has been designed in Proteus VSM simulation software for direct implementation of the program code. The motor model in Proteus has been calibrated with load to obtain the experimental motor characteristics followed by implementation of a close loop control scheme for variable load constant speed drive. Using this, a prototype has been fabricated and implemented in laboratory to validate the scheme. Method to reduce speed oscillations and to runs the motor at exact entered speed. This is achieving by using the microcontroller programming.

II. PRINCIPLE OPERATING PRINCIPLE OF BLDC MOTOR

A brushless dc motor is defined as a permanent synchronous machine with rotor position feedback. The motor needs a rotor position sensor for starting and for providing proper commutation sequence to turn on the devices. Based on the rotor position, the devices commutated sequentially for every 60 degrees. Here electronic commutations are use. This eliminates the problem associated with the brush and the commutator arrangement.

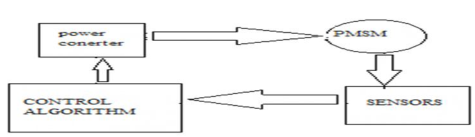

Fig 3.1 structure of BLDC motor

The basic block diagram of BLDC motor as shown. The BLDC motor consists of 4 main parts that are mentioned in the blocks. One

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of the prominent features of the BLDC motor is the rotor position sensors. The structure of the control algorithms regulates the type of the BLDC motor of which there are two main classes voltage and current based drives. Machine with sinusoidal back emf may be controlled so as to attain nearly constant torque.

III. HARDWARE IMPLEMENTATION DIAGRAM

Fig 3.2: Block Diagram for Hardware Implementation

The HEX code of the program is burned into the microcontroller chip using a software called PIC KIT 2Output section contains a motor driving IC L293D. Input pins of this IC have been connected to the microcontroller whereas output pins are connected to the DC motor. 12V battery is connected externally to Microcontroller is being used to control the complete system.

IV. PROTEUS VIRTUAL SIMULATION MODULATION

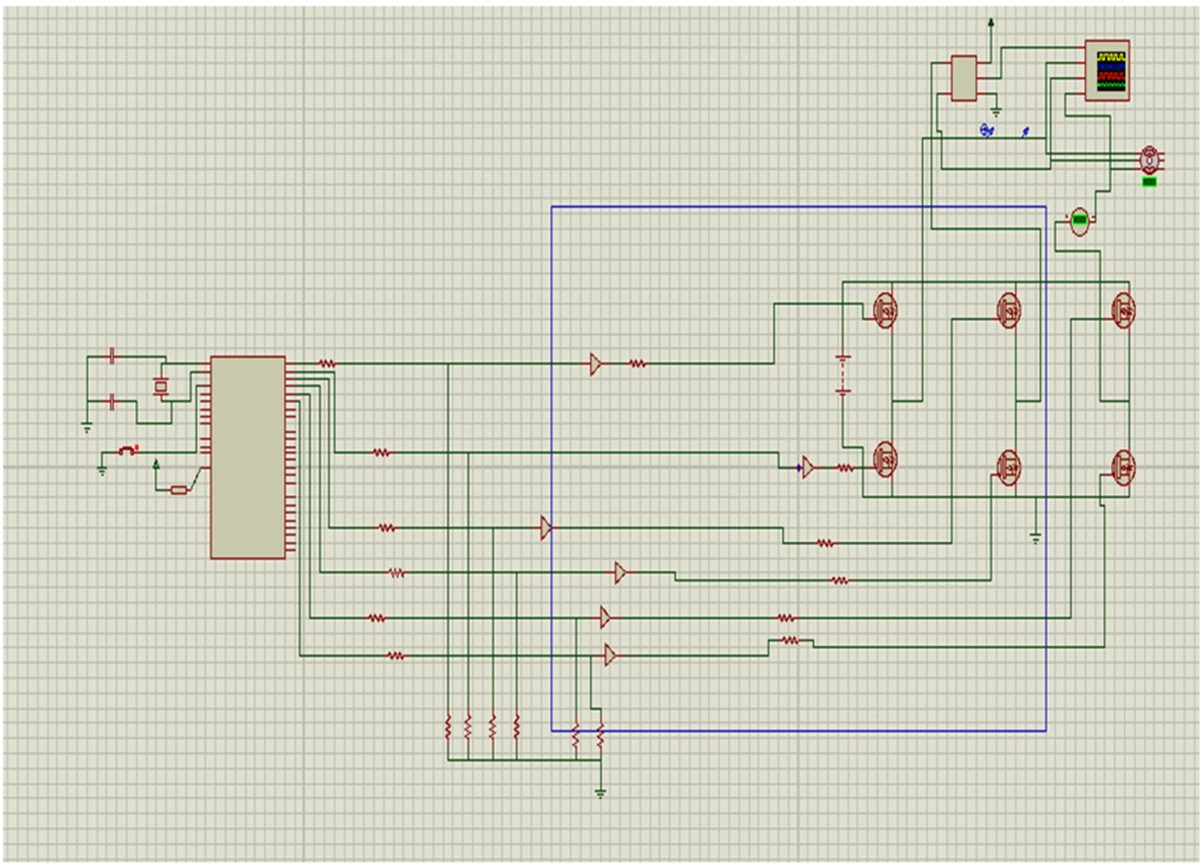

Fig 4.1 Proteus simulation circuit diagram

PIC16F877A is the brain of this project.5V power supply is connected to pin no. 1 which is MCLR (Master clear pin). Motor driving IC L293D is interfaced with microcontroller pin RB0 AND RB1 of port B. CCP1 pin of port C is connected to EN1 i.e. enable pin of L293D. A digital oscilloscope is also connected between two pins to see the output pulses generated by microcontroller. One push button switches are used to increase/ decrease the speed of motor DC motor to is connected to the output pins of L293D and 12V supply is given to it to drive the motor.

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V. EXPERIMENTAL SETUP AND RESULTS

Using Proteus software we did simulation and after implementation the device is connected to the oscilloscope for the characterization. Here the figure shows the connection of the device in the Laboratory.

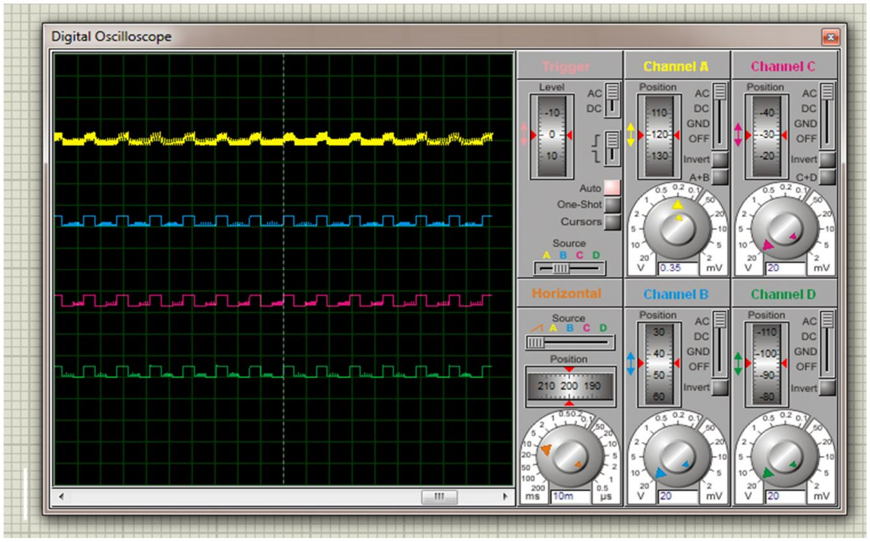

Fig 5.1 output pulses from oscilloscope

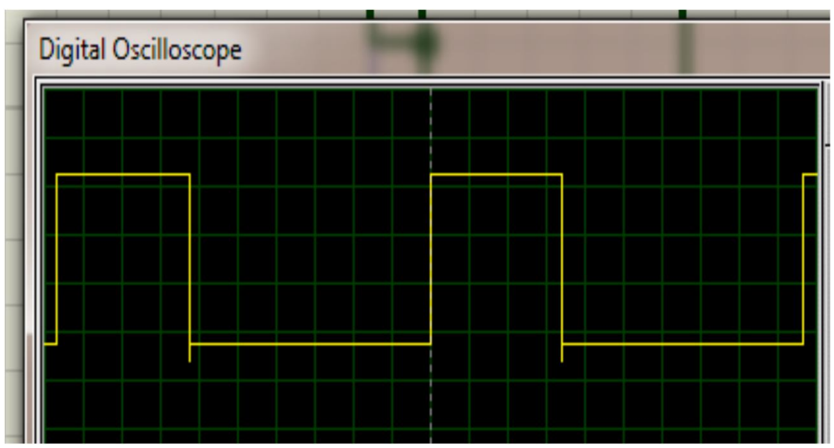

Fig 5.2 20 % duty ratio

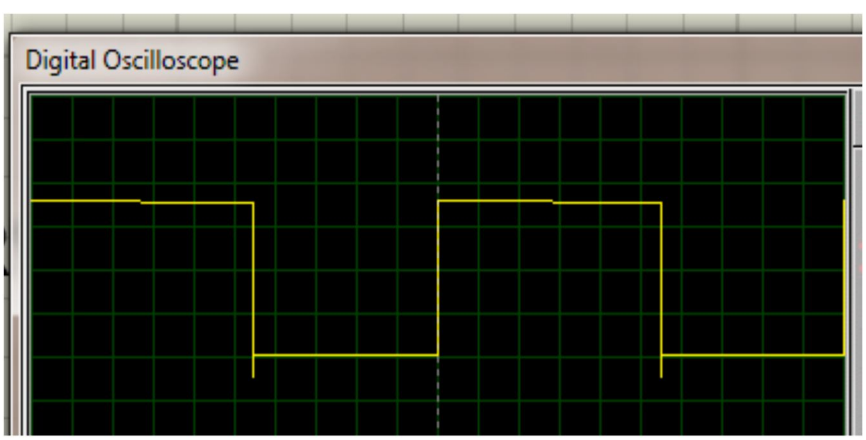

Fig 5.3 50 % duty ratio

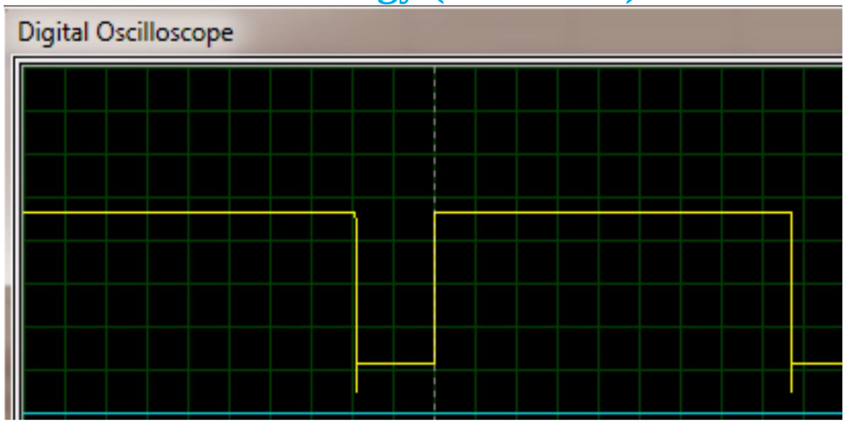

Fig 5.4 80 % duty ratio

Here the output pulses of various duty ratios were obtained. If the pulse width gets changed the speed also gets changed. Thus we can achieve the speed control of BLDC motor by varying the pulse width and the result can be simulated above.

VI. HARDWARE IMPLEMENTATION

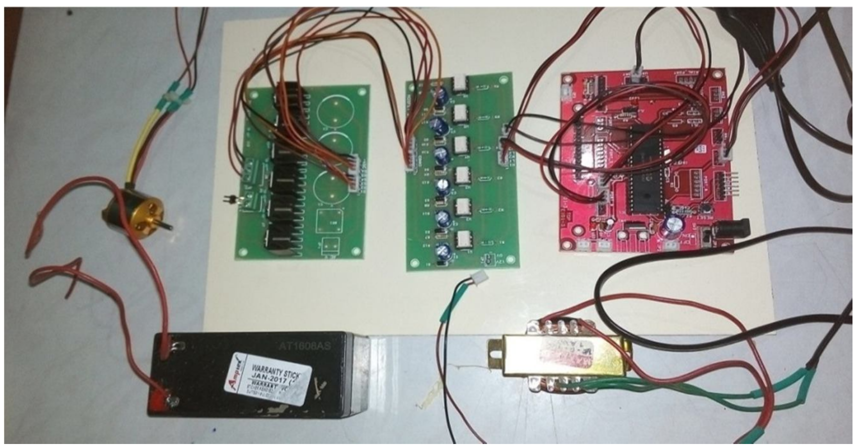

Fig 6.1 hardware implementation

Here the pic microcontroller got programmed by using mikro C pro software for giving pulses of various duty ratios. This will be given to driver circuit because the output from PIC is 5v it get regulated by using driver circuit and the output of driver circuit is given to inverter. This inverter in turns drives the motor by the pulse given by PIC and the motor runs according to the constant speed.

VII. SUMMARY AND CONCLUSIONS

This paper has presented a model of speed control of DC motor using PIC microcontroller 16F877A. By varying the PWM signal from microcontroller, the speed of DC motor is controlled. The laboratory test results confirm that the model created to control the speed of DC motor is operated at different speeds by varying duty cycle of PWM signal. The proposed method for control reduces the number of components because the microcontroller can integrate in one package all the functions. Thus the proposed technique well-matched for industrial applications. This project suggests a durable, accurate, reliable, and efficient way of speed control of DC motor.

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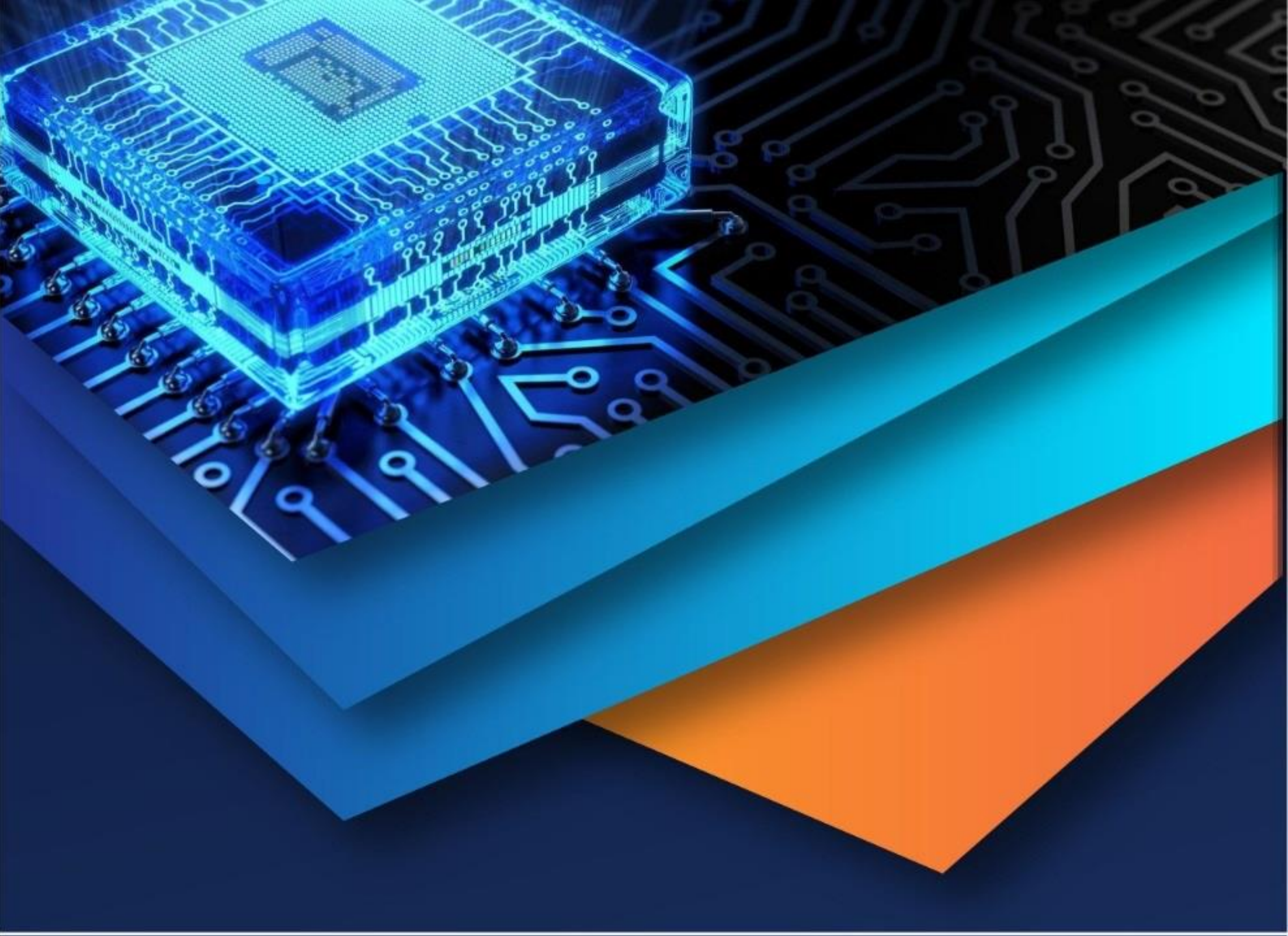

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