INTERNATIONAL RESEARCH JOURNAL IN ADVANCED ENGINEERING AND TECHNOLOGY (IRJAET) E - ISSN: 2454-4752 P - ISSN : 2454-4744
VOL 2 ISSUE 2 (2016) PAGES 783-789
RECEIVED : 25/03/2016. PUBLISHED : 02/04/2016
April 2, 2016

SPEED CONTROL AND FAULT ANALYSIS OF BLDC MOTOR USING FUZZY LOGIC CONTROLLER

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ABSTRACT

The electronically commutated Brushless DC motor are widely used in many industrial applications because of their high Efficiency, high torque and low volume. This paper proposed a improved fuzzy to control the speed and to analyse the open switch fault of brushless DC motor .Fuzzy has the ability to satisfied control characteristics and it is easy for computing. The experimental results are verified that a fuzzy as a better control performance than a conventional PID controller .The modeling, control and simulation of the BLDC motor have been done using the software package MATLAB/SIMULINK.

KEYWORDS: BLDC Motor Drive , Fuzzy logic controller, Fuzzy sets and rules, Speed control, Fault, Hall sensing.

[1] INTRODUCTION

BLDC motors have some advantages over conventional brushed DC motors and induction motors. In addition, BLDC motors are reliable, easy to control, and inexpensive. High performance BLDC motor drives are used extensively in industrial. The BLDCmotor drive is a highly controllable electrical motor drive suitable for robotic manipulators, position control, guided vehicles, steel and electrical traction. In recent years, the application of fuzzy logic control for high dynamic performance of motor drives has become an important subject research including control of dc and ac servo systems and ac induction drive systems. It is shown that fuzzy logic control is, indeed, capable of providing the high degree of accuracy required by high performance drive systems without the need for detailed mathematical models. Fuzzy logic control accommodates non-linearity without the utilization of mathematical modeling, while providing a reasonably accurate and robust real-time controller.Fuzzy logic controllers have been used successfully to control BLDC motor drives. The purpose of any speed regulator is to track a specified reference speed trajectory while rejecting any load or system excursions.The proposed method is based on the speed control and open switch fault analysis to protect the motor by using fuzzy logic controller.

C. PROPOSED METHOD

This project is implemented by a 3 Phase full bridge inverter topology with six switches in order to drive the BLDC Motor. The 3-phase full bridge arrangement was chosen for the power interface between the motor and controller. The full bridge was chosen for it higher torque output capability over a half bridge arrangement. The purpose of the bridge circuit is to enable each of the three motor phases to be switched on as required by the motor.

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INVERTER

A device that converts dc power to ac power at desired output voltage and frequency is called an inverter. Inverters can broadly classify into two types: VSI and CSI .A VSI, is one in which the dc source has small or negligible impedance. In other words a voltage source inverter has stiff dc voltage source at its input terminals. A CSI is fed with an adjustable current from a dc source of high impedance, i.e. from a stiff dc current source. In a CSI fed with stiff current source, output current waves are not affected by the load. In VSIs using thyristors, Some type of forced commutation is usually required. In case VSIs are made up of using power MOSFETs self commutation with gate drive signals is employed for their turn-on and turn-off.

SIX STEP THREE PHASE VOLTAGE SOURCE INVERTER

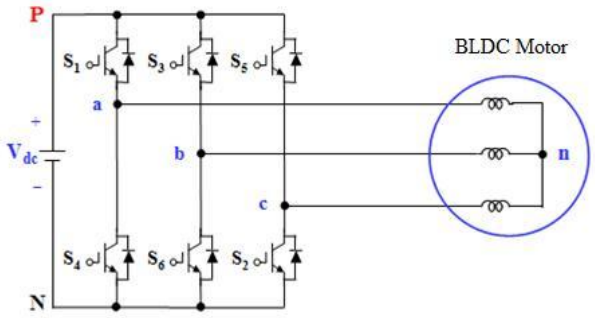

Fig.1.Three-Phase Voltage Source Inverter.

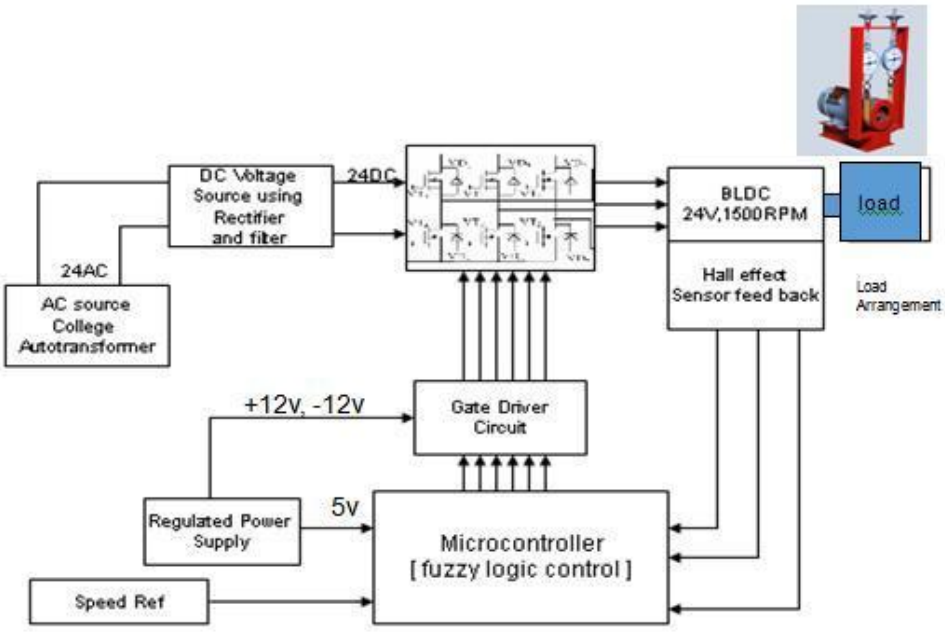

Fig.2.Block diagram of the proposed system

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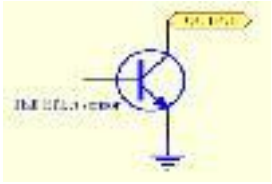
The MOSFET power inverter, BLDC Motor, fuzzy logic controller, Microcontroller and Hall sensing are used. The BLDC motor is an electronically commutated motor. The built-in hall sensors generate three signals according to the rotor position. Here the input is given as available single phase AC source. It been passed to phase controlled rectifier where it is converted from AC to DC. The filter present is used to remove the harmonics in the DC source.

Then it is passed through the single phase to three phase inverter where the uncontrolled DC is converted to pulsated or controlled DC.

The pulsated DC current is used to start or run the BLDC motor. The rotor position is sense by the Hall Effect sensor and the signal is been amplified by the signal condition. The amplified signal is passed to the microcontrollers. Using embedded c coding program is burned in the IC 16F877A by using CCS complier.. Here the controller compares the reference set speed and the actual speed and it varies according to it and determines the error speed and generate the control signal which sends the to the MOSFET inverter circuits. These signals are energize the appropriate windings by switching the appropriate switches in the power inverter. Thus the speed of the BLDC motor is controlled and the open switch fault is detected by using the microcontroller(Fuzzy).

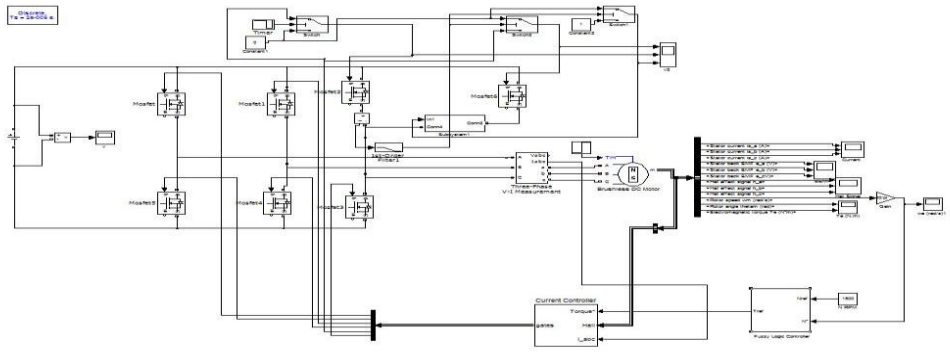
Hall Effect Sensor Interface

Most brushless DC motors have incorporated in the stator several Hall Effect sensors. These sensors provide rotor position information to the motor controller.



These devices require a pull up resistor from the collector to a positive supply voltage. In this case the sensor is pulled up to +12volts. The micro controller can only support input voltages up to +5V. To clamp the output voltage, 5.1-volt. To minimize power dissipation in the Hall Effect sensors by limiting current, 10kΩ pull up resistors are used.

2.1 SIMULATION CIRCUIT



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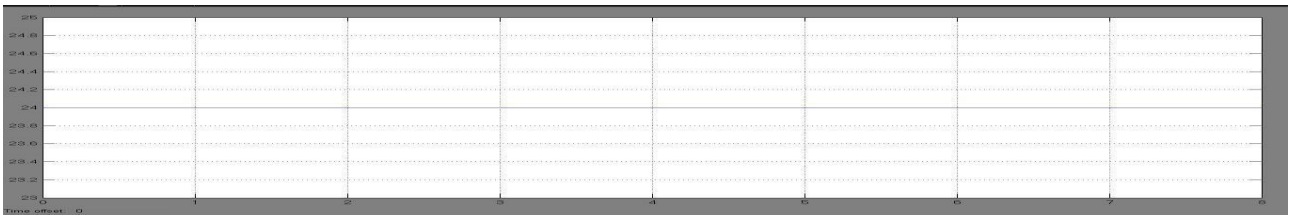
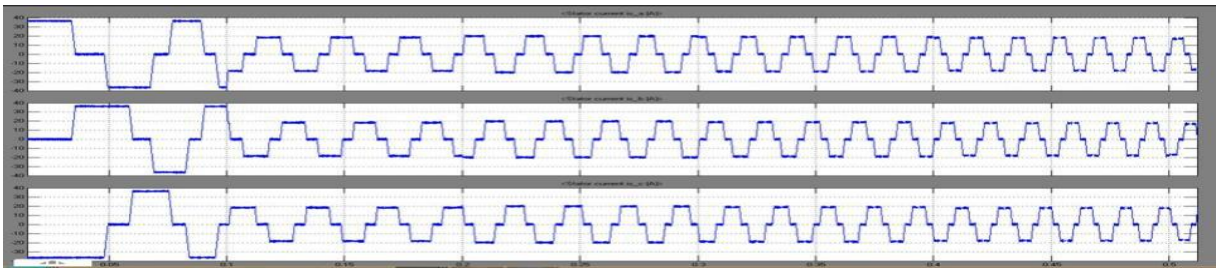
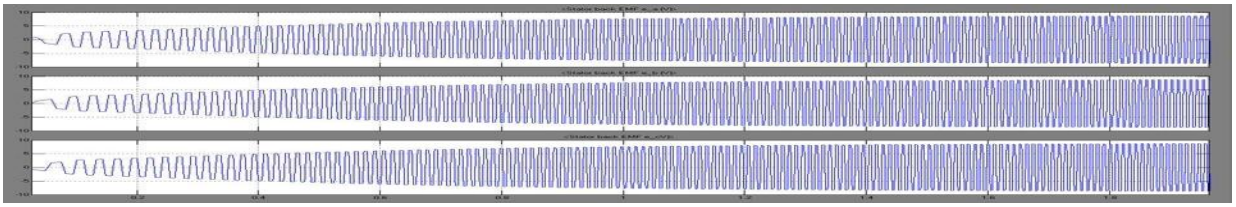
IV. SIMULATION RESULTS INPUT VOLTAGE



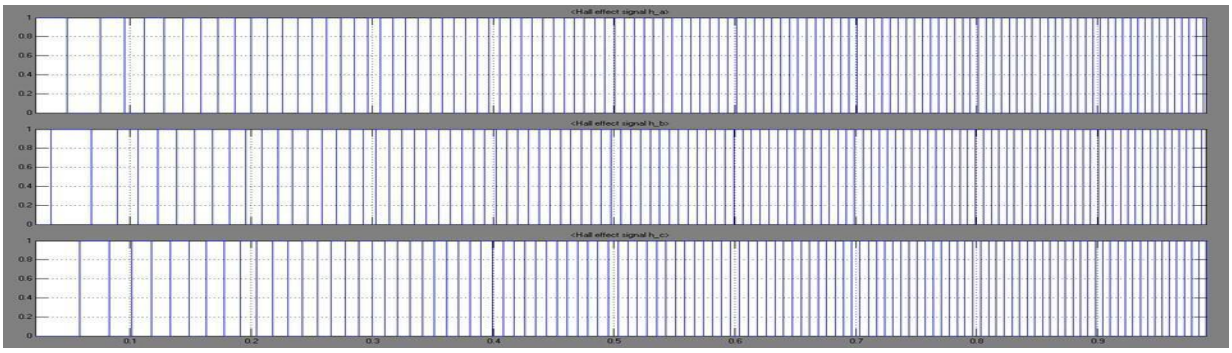
STATOR CURRENT



EMF



HALL SIGNAL



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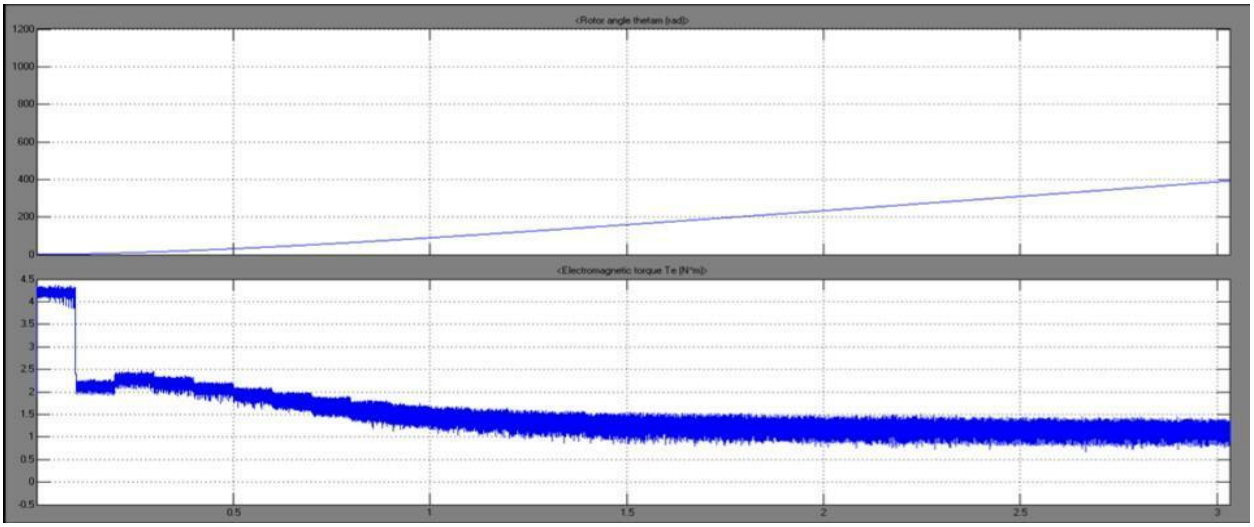
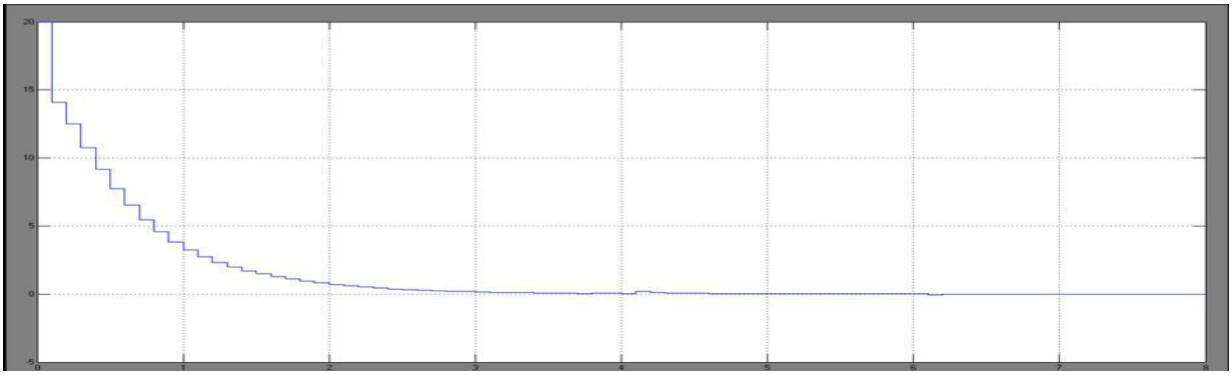
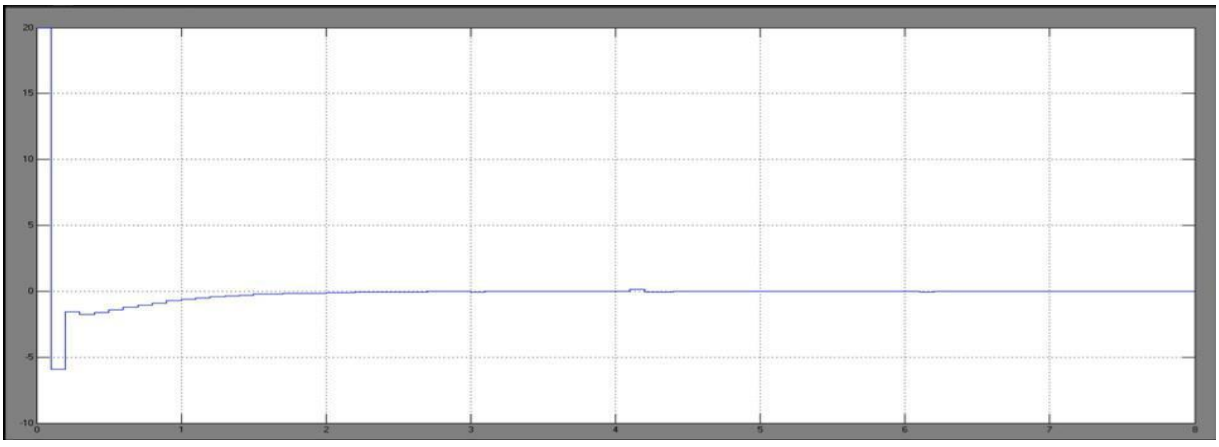
TORQUE



FUZZY INPUT 1



FUZZY INPUT 2



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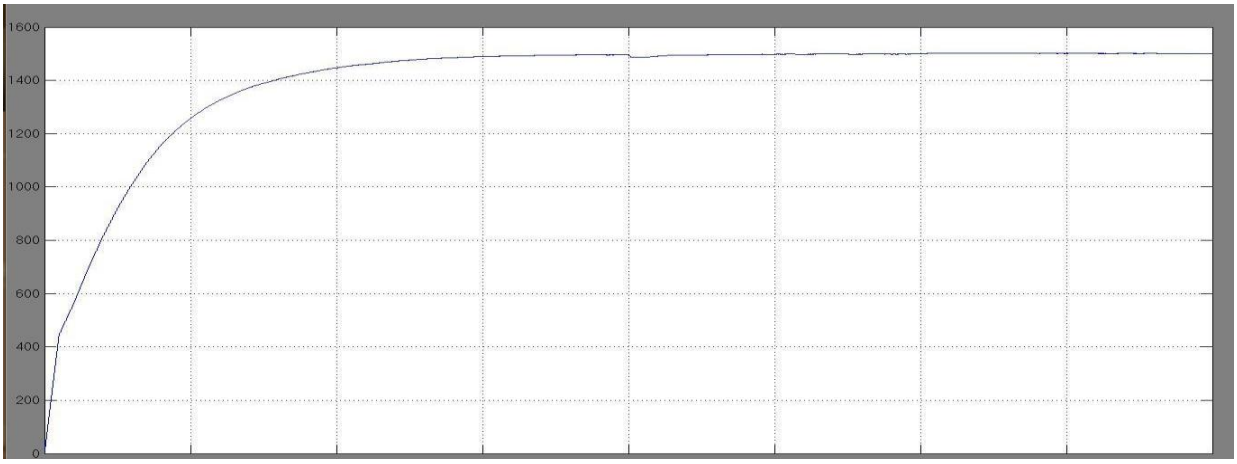
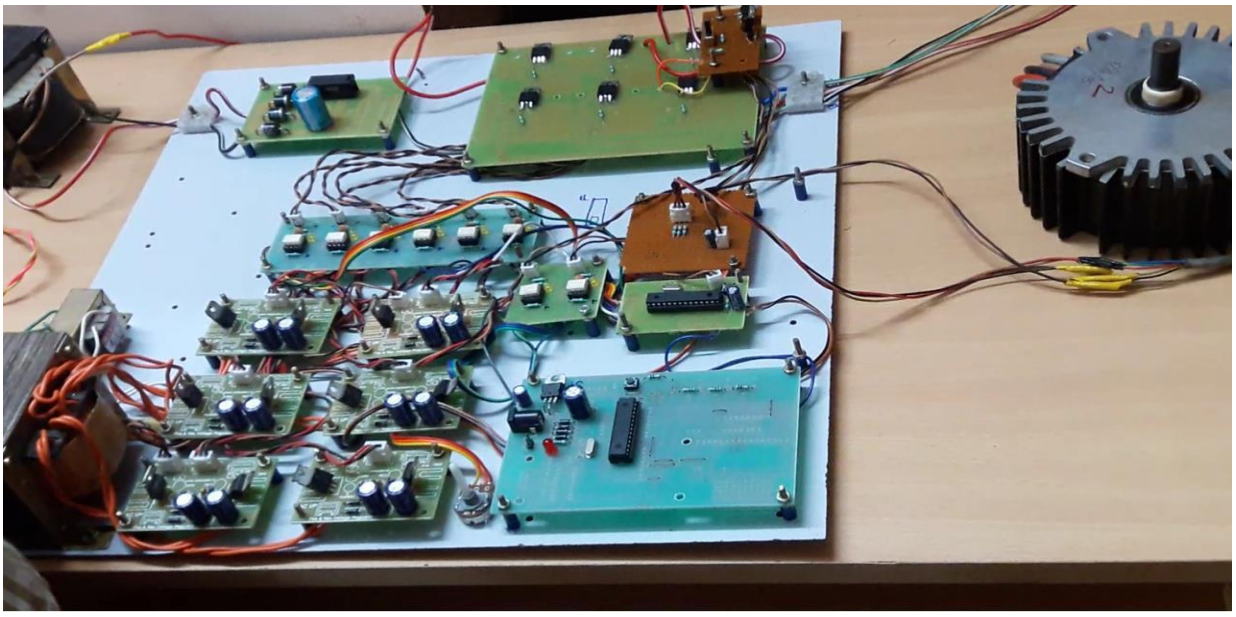
SPEED



HARDWARE SETUP



CONCLUSION

The speed control and Open switch fault protection of BLDC motor was obtained successfully by using the fuzzy logic to maintain a close operation of maintaining the load constant with the variation in the load. The fuzzy logic speed controller for BLDC motor using a microcontroller is designed, implemented and tested. The set speed is varied and the variation in the motor speed is measured and the performance of drive is found to be excellent. And this entire drive can be put in a compact module and it can be used for speed control applications.

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