TEST Engineering & Management

May – June 2020
ISSN: 0193-4120 Page No. 7496 - 7500

Speed Control of BLDC Motor Using Voice Command By Implementing Machine Learning

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Article Info
Volume 83
Page Number: 7496 - 7500
Publication Issue:
May - June 2020

Article History
Article Received*: 19 November 2019*
Revised*: 27 January 2020*
Accepted*: 24 February 2020*
Publication*: 18 May 2020*

Abstract:

The paper deals with the control of speed of BLDC motor drive in a closed loop control technique. NodeMCU is used as a microcontroller where machine learning program is implemented. According to the desired speed given by the user via voice command, the motor will run at the exact speed. Instead of using speed sensor, the stator back -emf is used to estimate the rotor speed.

Keywords: *Machine learning ,Node MCU, Bridgeless zeta converter, Sensorless, Bluetooth, BLDC motor.*

INTRODUCTION

The proposed technique uses NodeMCU to control the speed of the BLDC motor because it is reliability,energy consumption ,compact, low cost and its ability to connect whole system to Wi-Fi..When compared to other motors ,BLDC motor has following advantages such as high reliability,low maintanence,high efficiency and the long operating life. Hall effect sensor are mostly senses the rotor position but here the rotor position is determined by stator back emf estimation technique.

In this system a sensorless BLDC drive is being implemented by using NodeMCU operating at 16MHz,that digitally filters the back emf noise(BEMF) to obtain the rotar position and generate PWM commutation sequence to spin the motor.These controller not only decrease the cost and space,it also reduces back emf noise and reduces the cogging torque on rotor.

In sensorless operation,the voltage divider has been used to check the speed instead of the hall sensor, so it is called as the sensorless operation. The Bluetooth module is connected with the mobile phone by using a password. So only the authorized person can use the password to connect it with the Bluetooth module and they can change the speed. In the mobile phone , a app is installed which will convert the speech into text and the text will be sent to the Bluetooth module and from that it is given to the node MCU and where it will compare the speed which is given by the user with the speed in which the motor is running and the output from the Node MCU will decide whether to increase or to decrease the speed respect to that of the motor speed. With

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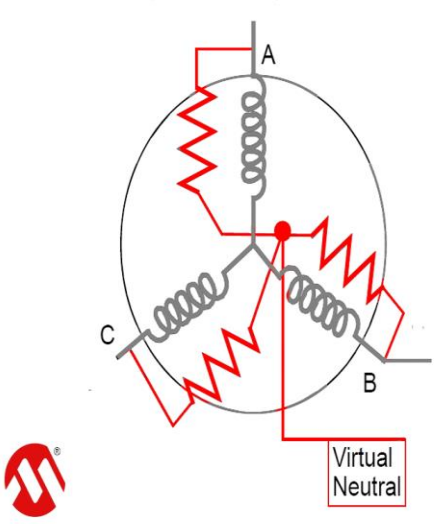
the help of the voltage divider the back emf voltage has been sensed and given it to the Node MCU ,where the program is built in it which will convert voltage to the speed..

In this system a sensorless BLDC drive is being implemented using NodeMCU operating at 16MHz, that digitally filters the BEMF (Back-EMF) noise to obtain the rotor position and generate precise PWM commutation sequence to spin the motor. These controllers not only decrease the cost and space; it also reduces the BEMF noise and reduces the cogging torque on rotor. Thus, a BLDC motor that runs smoothly with less audible noise. In this system the wired connection is replaced by android based user interface. In which the user needs to put only minimum effort.

I. PRINCIPLES OF THE PROPOSED SENSORLESS DIRECT SPEED DRIVE

In the proposed method, the motor speed is compared with the user speed by use of the Node MCU. The back emf from the motor is sensed by the voltage divider.This *determine the motor voltage to determine rotor position and speed.* This approach yields a much higher resolution than the rotor position.The voltage divider has three resistance which sense the voltage from the motor and gives its required voltage pulse to node MCU. Thus node MCU is programmed in a specified way that by receiving the voltage pulse *from voltage divider speed of the BLDC motor is calculated. Thus the motor speed can be calculated. The sensor use has been avoided .So the cost can be reduced and size is compact*



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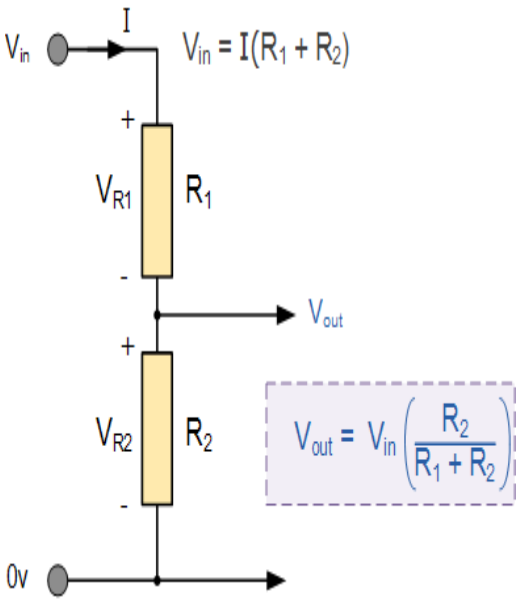
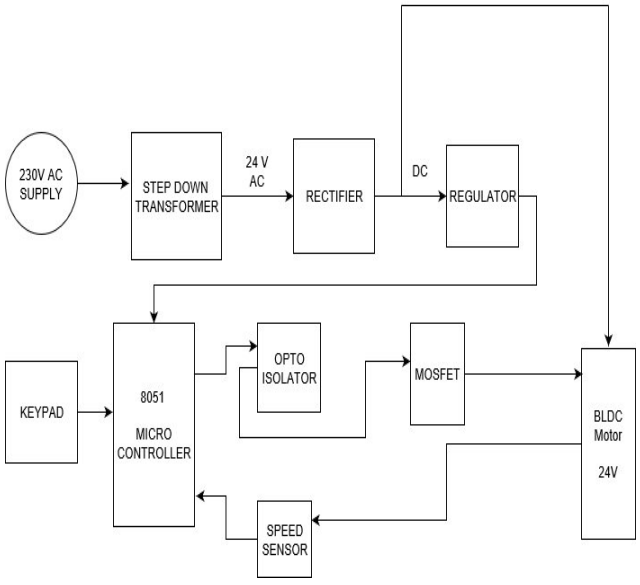
II. VOLTAGE DIVIDER



The voltage divider is used to sense the Back EMF voltage from the BLDC motor. The voltage of the motor can be taken in the running condition. When the motor starts to run there will be some voltage developed across it with respect to that of the motor speed. From the voltage divider, the voltage thus taken from the motor is fed back to the Node MCU, where it will compare the speed given by the user via bluetooth with that of the motor speed This is the working of the voltage divider.

III. EXISTING SYSTEM



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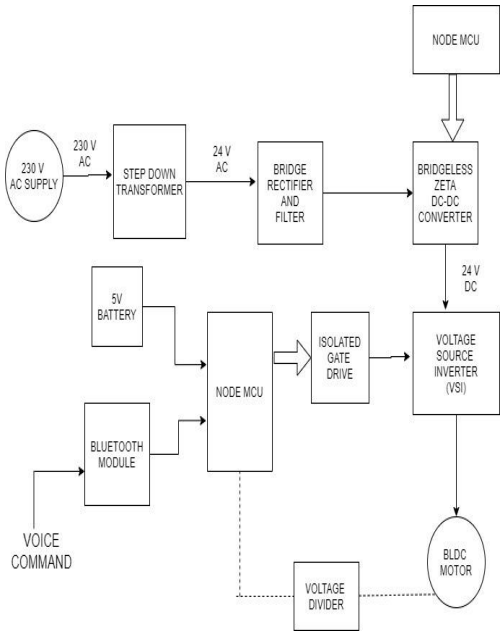
describes the overall system design for the Closed loop speed control of BLDC motor. The PIC microcontroller uses a PWM to control the period of the motor drivers and, thus set speed. Feedback from the hall sensor is fed into the PIC microcontroller. The PIC MCU continuously monitors motor speed by measuring the output period of the Hall effect sensor. The desired speed is given to the microcontroller by the keypad, then by comparing the desired speed with the motor speed a error signal will be produced which will increase or decrease the speed according to the user's command. From the microcontroller the output is given to the opto isolator which will make the BLDC motor to run in the desired speed.

IV. PROPOSED SYSTEM



The proposed system consists of an LC filter, BL Zeta converter, three-phase VSI, BLDC motor. The AC source is fed to the step-down transformer and then it passes to the LC Filter to eliminate the high-frequency noise in the input signal. This noise-free signal is fed to BL Zeta Converter where the AC signal is converted into DC signal. The converter consists of two MOSFET switches. It consists of five inductors, four capacitors and four diodes. The voltage across the capacitor is regulated to produce variable DC bus voltage. This ensures a constant supply of power to the VSI during both positive and negative half cycle. The DC voltage obtained from the BL Zeta converter is supplied to the VSI containing six MOSFET switches. The job of the VSI is to convert the DC signal into pulsating AC signal as required by the BLDC motor. . The rotor position of the motor is sensed with the help of voltage divider that The MOSFETs are switched in fundamental frequency, resulting in the reduction of losses pertaining to the switching of power electronic switches.

The Node MCU compares the reference speed given via the Bluetooth with the speed obtained by the voltage divider. The error voltage thus obtained is given to the PWM generator. The PWM generator controls the duty cycle of the gate pulses that drive the MOSFETs in the BL Zeta converter. By changing the pulse, the BLDC motor runs at the desired speed.

V. SIMULATION:

The simulated block diagram in proteus is shown below:

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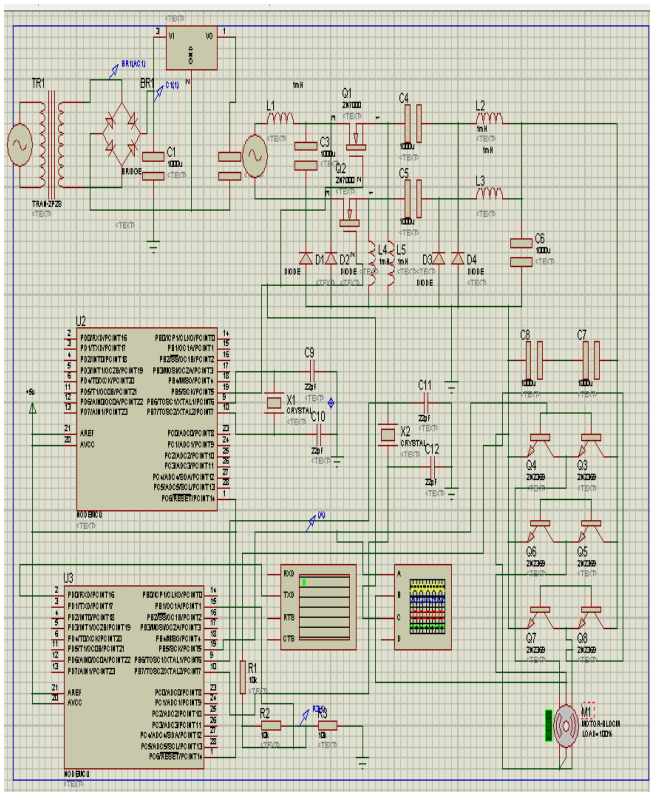
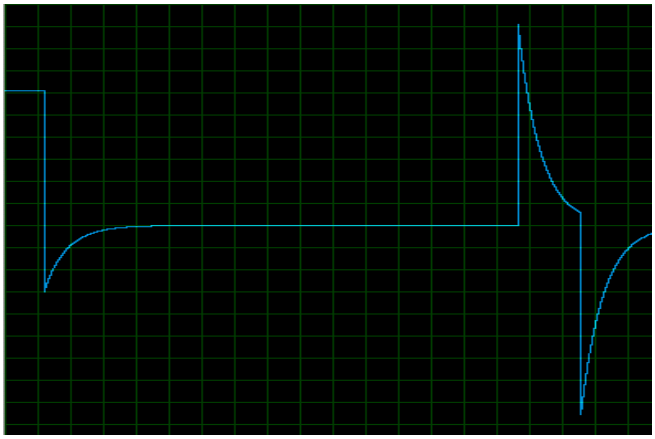
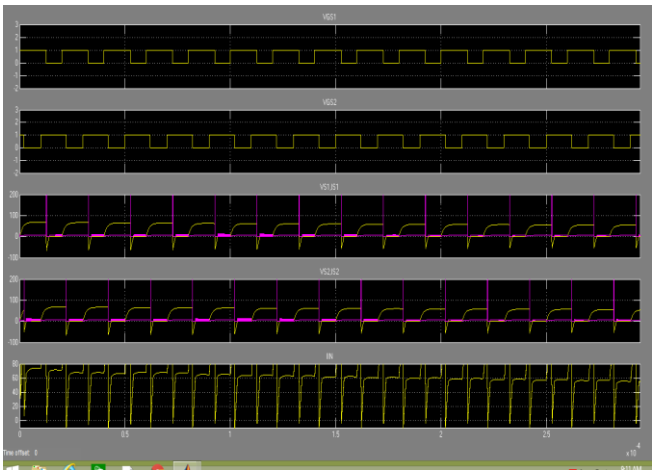


The simulated output of the proteus is shown below:

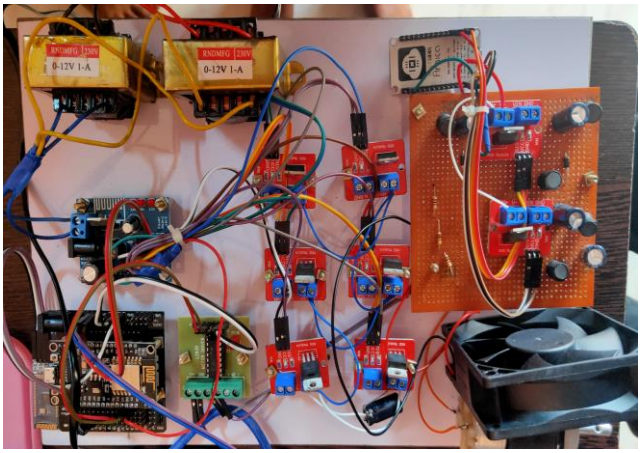


The proteus stimulated output is shown which is drawn for speed torque characteristics

Step by step output of bridgeless zeta converter:



VI. HARDWARE IMPLEMENTATION



VII. ADVANTAGES OF PROPOSED SYSTEM:

- NODEMCU is used instead of 8051 microcontroller.
- The desired input is given via voice command.
- It provide arduino based user interface

VIII. CONCLUSION

A BL Zeta converter based motor has been designed and developed for adjustable speed domestic applications. Minimum switching losses have been achieved by low-frequency switching operation of VSI with variable voltage control of DC bus for controlling the BLDC motor speed. The NodeMCU has been used to produce PWM pulses. Experimental performances of the system have been established quite well for the control of speed over a broad range of supply. Thus speed control of the BLDC motor can be done via the voice command.The performance of the system can be analyzed for various controllers.

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