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THREE PHASE BLDC MOTOR CONTROLLING USING BOOST CONVERTER

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Abstract: Brushless DC Motor overcomes several issues of the brushed DC Motor and has been wide applied in numerous fields. the event of BLDCM system needs reliable operation, glorious performance of management algorithmic rule, low value and short development cycle. The dominance of BLDC motor exploitation Boost device is proposed in this study. The driving system's flexibility is increased by using a PIC microcontroller. The BLDC motor is driven by a three-part driver circuit that makes use of MOSFETs. The proposed system is configured for desired speed and leverages Hall device signals from the motor. The results confirm the driving operation that was established.

Keywords: *Brushless DC motor (BLDCM), Hall sensors, Microcontroller.*

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I INTRODUCTION

A brushless DC motor (BLDC) is an electrically commutated DC motor without brushes. In comparison to DC motors, BLDC motors employ an electrical electrical switch rather than a mechanical electrical switch, making them far more dependable. Because rotor magnets create the rotor's magnetic flux in a BLDC motor, BLDC motors have a greater potency. It's possible because of their high performance in terms of high potency, quick response, and weight, as well as proper management, high reliability, maintenance-free operation, brushless construction and reduced size, a high force-to-motor-size magnitude relationship, and thermal overload and below-load protection.

Microcontrollers have many advantages over microprocessors. These ICs are less costly and may be utilised in a variety of applications, including appliances, automotive engines, and text and processing equipment. They provide high-resolution management and decrease management loop delays due to their increased performance. These cost-effective controls allow for the reduction of force ripples and harmonics, as well as the enhancement of dynamic behaviour across all speed ranges.Power parts and input filters can be optimised using sleek waveforms. Switching electrical devices from traditional digital control to microcontroller control enhances operating efficiency while conserving energy and allowing the use of smaller, less expensive motors.

The goal of this project is to design a dominating mistreatment boost converter for BLDC motors. The performance of convertor settings will be evaluated and identified using a variety of PWM switch schemes. The system's open loop and closed-loop speed management has been completed, and the results have been collated to validate the effective designed drive functioning.

Block Diagram Of The Control System

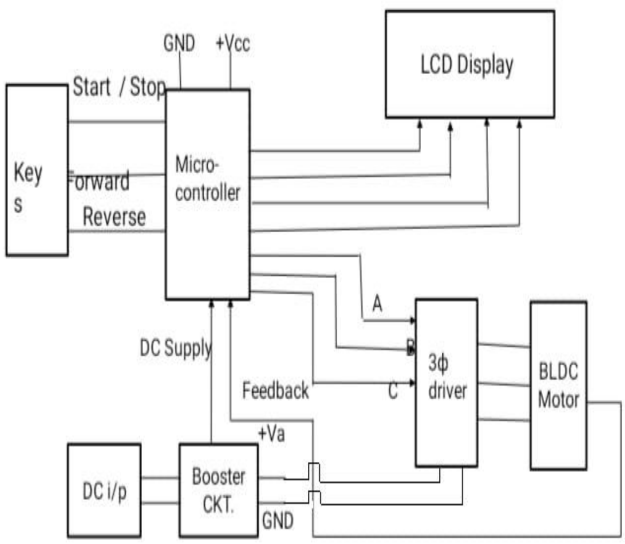

Fig 1: Block diagram of propose system

Figure 1 shows a block schematic of a BLDC drive system. DC battery, buck-boost converter, PIC microcontroller, LCD display, three-phase driving circuit, and position sensors make up the system.

To rotate the motor, the stator windings must be provided. The rotor should be positioned such that the windings are switched in the correct order. A permanent magnet brushless dc motor has a mechanism for sensing the position of the rotor.

The rotor victimisation Hall sensors are detected by the BDLC motor. For position data, three sensors are required. Vi potential commutation sequences could be obtained using three sensors. Three Hall sensors, positioned 120 degrees apart, are used in the Hall sensing element approach.

The polarity of the magnetic pole on the tip of each Hall sensing device determines whether it produces a High or Low output. The outputs of all three Hall sensors control the rotor position. The voltages to the motor's three-phase area unit altered to accommodate the output from hall sensors. The benefit of using Hall sensors for commutation is that the management algorithmic rule is simple and easy to understand. Hall sensor-based commutation can even cause the motor to run at extremely low speeds.

The microprocessor controls the force and speed of the motors. To unravel the algorithms required to provide Pulse Breadth Modulated (PWM) outputs for motors, significant processing power is necessary. The speed of the motor may be controlled simply by varying the voltage across it. Variation of the motor voltage may be performed easily by adjusting the duty cycle of the PWM signal after using PWM outputs to manage the six switches of the three-phase bridge. Victimization closed-loop system configurations complete the three-phase BLDC speed management.

The duty cycle of the PWM signals that control the motor-drive electrical equipment is directly dominated by closed-loop system management, which regulates the motor speed. The main difference between the two management systems is that open-loop management only considers speed management input to update the PWM duty cycle, whereas closed-loop management considers both speed input management and actual motor speed (feedback to controller) to change the PWM duty cycle and, in turn, the motor speed. A pelvic inflammatory disease controller is a widely used closed-loop control solution that is often employed as a feedback controller.

The real motor speed is determined by calculating the time between serial Hall occurrences, which indicate a portion of the motor's mechanical cycle. One electrical cycle in a three-phase BLDC control includes six Hall states, and depending on the number of pole pairs in the motor, the electrical angle recorded between serial Hall state transitions is translated to a single mechanical angle.

II EXPERIMENTAL SET UP

The proposed system is first modelled and then implemented in the laboratory. The simulations have been delivered using MATLAB 7.13. PIC18F26K22 enforces the managerial theme. The package software is written in C. The programming is done with the MPLAB Integrated Development Environment (IDE) tool. The MPLAB C30 compiler is used to execute C code.

BLDC motor:

The BLDC motor specifications square measure as shown in Table one.

Table 1: BLDC motor specification

Type of motor - BLDC MOTOR

Stator voltage - 24v

Power rating - 250watts

Speed - 3000rpm

No. of poles - four

No. of turns - eight

Degree - 60^o

- **Buck-boost converter:**

The buck-boost converter receives 12V DC power from a DC battery. The buck-boost converter is used to adjust the voltage based on the device that is connected to it. Buck converter converts 12V DC to 5V DC and supplies 5V DC to microcontroller in this example. The boost converter converts 12V DC to 24V DC and supplies that voltage to the driver circuit, allowing the motor to run.

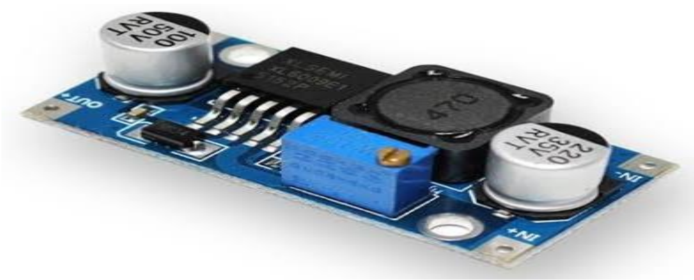

Figure 2-A buck-boost converter circuit

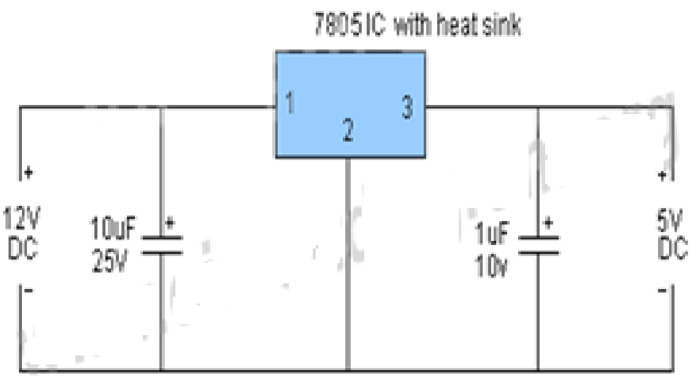

Fig2.B:Buck converter circuit

- **Three phase driver circuit:**

The negative feedback circuit is made up of a MOSFET-based driver circuit that generates pulses at the required frequency of nineteen times per second. The inner timer is used as a clock to determine the temporal sequence, and the counter is used to tally the pulses received from the proximity sensing element. The frequency of the pulse to be applied to MOSFET is determined by a software system programme. The system is implemented with the help of a DSCPIC18F22 based PWM electrical converter. MPLAB IDE v7.2 was used to develop the environment for this application.

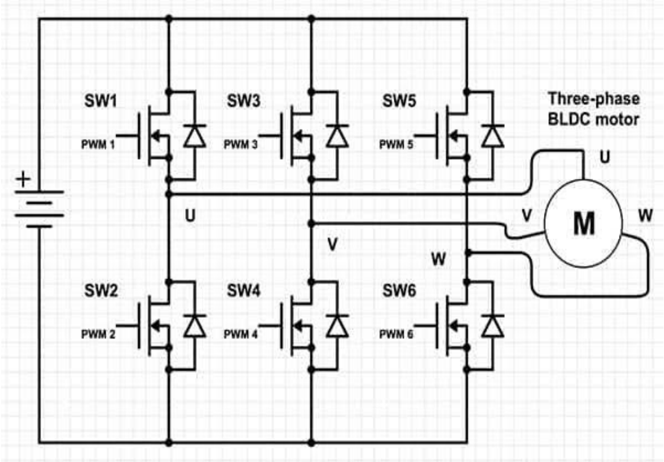

Fig3. Three phase driver circuit

Fig 4: Hall sensor signals ABC

Fig 4. PWM generated by driver circuit.

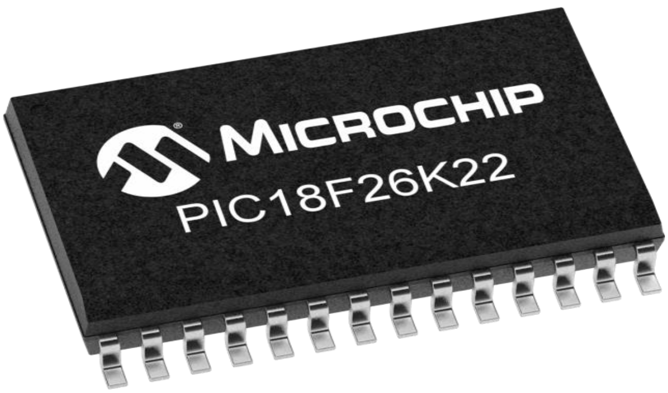

Fig 5. Microcontroller(PIC18F26K22)

This project makes use of the PIC 18F26K22 microcontroller. PIC 18F26K22 is a low-voltage microcontroller that runs on 5V DC. Under software control, it may self-reprogram. It gets 5V DC from the buck converter and generates PWM (Pulse width modulation). We require PWM at 24V to power a BLDC motor, however the PWM supplied by the microcontroller is at a low collage. As a result, it gives to the driver circuit, which operates the motor, to raise the voltage of this PWM.

- **LCD Display:**

Fig 6. LCD display

16*2 LCD display is used to display the speed of BLDC motor. It is connected to microcontroller. LCD are generally easy to use.

III ACTUAL PROJECT SET UP :

Fig.7 and Fig.8 shows the actual set up of project respectively.

Fig. 7A : Project Setup

Fig. 7B : Project Setup

IV RESULTS:

The configuration is put to the test for motor control system management, and the results are tabulated.

The system selects a desired speed and adjusts the voltage delivered to the motor to induce the required speed in closed-loop operation. The specified speed is read from an external potentiometer by the A/D converter in the first stage of the control system. Reference Speed is provided by the A/D converter.

The measured speed is the second component of the closed loop, and it is used to raise or decrease the motor's output voltage based on the computed error between the stated and measured speeds. For motor control system management, the proportional worth KP is about zero.30 and KI is about 0.20.

Table 3 displays the experimental set and real speed values in rpm.

SET SPEED (rpm)	ACTUAL SPEED (rpm)
300	301
400	409
500	503
600	592
700	715
800	816
900	903
1000	1009
1100	1103
1200	1245
1300	1311
1400	1429
1500	1521
1600	1597
1700	1715
1800	1808
1900	1901
2000	2065
2200	2100
2500	2447

Table 4: Experimental values of duty cycle & actual speed in rpm

DUTY CYCLE	Actual speed (rpm)
20	490
25	608
30	789
35	917
40	1123
45	1236
50	1424
55	1514
60	1765
65	1946
70	2117
75	2117

V CONCLUSION :

The algorithmic programme has been implemented, and it creates PWM to operate the MOSFETs in the three-section totally controlled bridge converter. Using a PIC18F26K22Controller, the produced PWM signals for operating the BLDC motor are successfully tested. The output from the converter is delivered to the BLDC motor's three-section stator coil winding, and the motor is also operated. The programme is very cost-effective, and the results with the designed hardware are excellent. The designed management and power circuit works well and meets the application requirements. The created driving styles are successfully justified by the experimental results.

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