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BLDC MOTOR SPEED CONTROL USING MICROCONTROLLER

[1]Nalkande Ravindra, [2] Atish Kharat, [3] Aniket Rayker, [4] Nemane Rohan

[1]UG Scholar, Department of Electrical Engineering. JSPM's Polytechnic, Wagholi, Pune
2UG Scholar, Department of Electrical Engineering. JSPM's Polytechnic, Wagholi, Pune
3UG Scholar, Department of Electrical Engineering. JSPM's Polytechnic, Wagholi, Pune
4UG Scholar, Department of Electrical Engineering. JSPM's Polytechnic, Wagholi, Pune
ravindranalkande87@gmail.com

ABSTRACT:- The equipment paper is intended to control the speed of a BLDC motor utilizing close loop control strategy. BLDC engine has different application utilized in ventures like in lath machines, turning, electric bicycles and so forth The speed control of the DC engines is fundamental. This proposed framework gives an exact and powerful speed control framework. The client can enter the ideal speed and the engine will run at that precise speed.

KEYWORDS:- position Brushless DC motor, Microcontroller.

I. INTRODUCTION

Permanent-magnet excited brushless DC motors are becoming increasingly attractive in a large number of applications due to performance advantages such as reduced size and cost, reduced torque ripples, increased torque-current ratio, low noises, high efficiency, reduced maintenance and good control characteristics over a wide range in torque–speed plan, When all is said in done, Brushless DC engines, for example, fans are more modest in size and weight than AC fans utilizing concealed shaft or Universal engines. Since these engines can work with the accessible low voltage sources, for example, 24-V or 12-V DC supply, it makes the brushless DC engine fans helpful for use in electronic hardware, PCs, portable gear, vehicles, and shaft drives for circle memory, on account of its high unwavering quality, productivity, and capacity to turn around quickly. Brushless dc engines in the fragmentary pull range have been utilized in different sorts of actuators in cutting edge airplane and satellite frameworks [1-4]. Most famous brushless DC engines are principally three stages [5-7] which are controlled and driven by full extension semiconductor circuits. Along with applying lasting magnet excitation, it is important to get extra force parts. These segments can be gotten because of a distinction in attractive permeance in both quadrature and direct hub; hence, hesitance force is created and force invalid districts are diminished fundamentally [8, 11]. In this paper, a brushless DC engine with conveyed winding and an extraordinary type of PM-rotor with unique stator outskirts are portrayed. Which build up a speed control framework for a BLDC engine by shut circle control strategy. The proposed framework utilizes a microcontroller of the 8051 family and a redressed power supply. A set of IR transmitter and photodiode are connected to the microcontroller for counting the number of rotations per minute of the DC motor as a speed sensor. Optocoupler is connected to trigger the MOSFET for driving the BLDC.

II. TYPES OF CONTROL TECHHIQUE OF BLDC MOTOR

In spite of the fact that different control procedures are examined in [8] essentially two strategies are accessible for controlling BLDC engine. They are sensor control and sensor less control. To control the machine utilizing sensors, the current situation of the rotor is needed to decide the following compensation stretch. Engine can likewise be constrained by controlling the DC transport rail voltage or by PWM technique. A few plans use both to give high force at high burden and high proficiency at low burden. Such crossover configuration likewise permits the control of consonant current [9]. If there should be an occurrence of regular DC engines, the brushes naturally come into contact with the communtator of an alternate loop making the engine proceed with its pivot. But in case of BLDC motors the commutation is done by electronic switches which need the rotor position. The appropriate stator windings have to be energized when rotor poles align with the stator winding. The BLDC motor can also be driven with predefined commutation interval. But to achieve precise speed control and maximum generated torque, brushless commutation should be done with the knowledge of rotor position. In control methods using sensors, mechanical position sensors, such as a hall sensor, shaft encoder or resolver have been utilized in order to provide rotor position information.

III. CONSTRUCTION AND OPERATING PRINCIPLE

Brushless DC motors were developed from conventional brushed DC motors with the availability of solid state power semiconductors. Brushless DC motors are similar to AC synchronous motors. The major difference is that synchronous motors develop a sinusoidal back EMF, as compared to a rectangular, or trapezoidal, back EMF for brushless DC motors. Both have stator created rotating magnetic fields producing torque in a magnetic rotor.

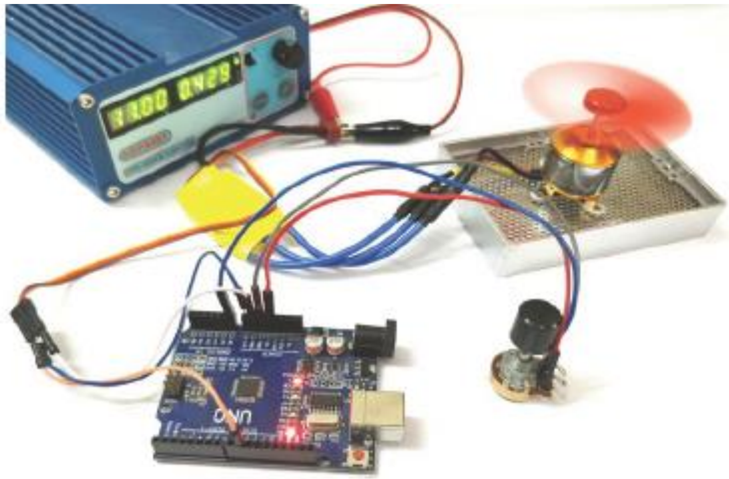


Fig.1 : Construction of BLDC motor

The basic construction of a brushless-dc consists of a fan blade attached to a permanent magnet rotor that surrounds the electromagnetic coils of the stator and associated control electronics.

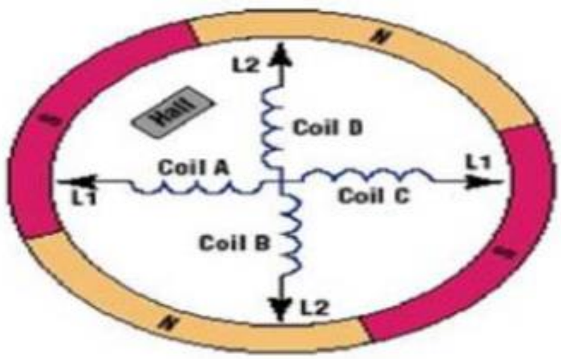


Fig.2 : DC Motor schematic diagram

made from a permanent magnet rotor assembly that surrounds four electromagnetic coils. The coils work in pairs, with coils A and C forming one phase and coils B and D the other phase. A Hall effect sensor monitors rotor position, providing feedback to the embedded MCU for commutation, speed regulation, and fault detection.

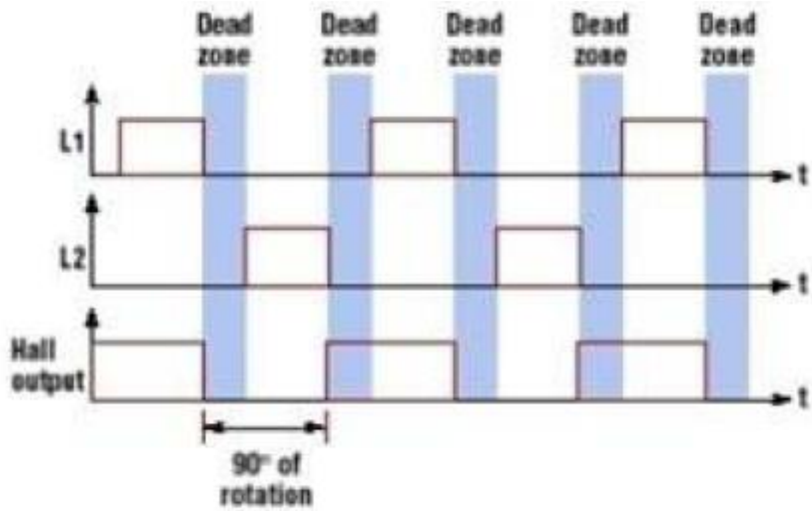


Fig . 3: Commutation Timeline Diagram

Commutation between the two phase windings in the dc fan takes place electronically by alternately applying power to L1 and L2. Dead zones between the power pulses limit current for speed control and helps minimize a cogging effect when the rotor magnets align with the stator coils. The on-and-off power of the commutation period resembles the output from a pulse-width modulator, or PWM.

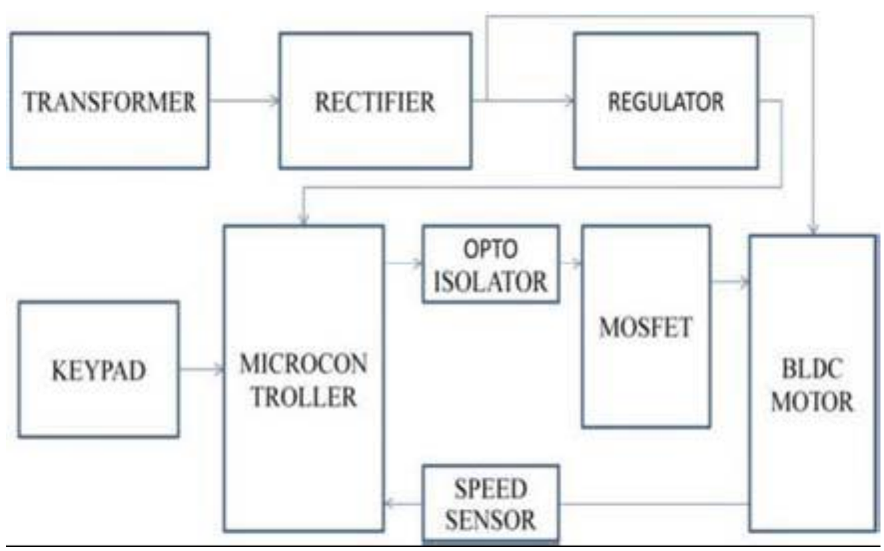


Fig .4 : Block Diagram

Feedback from the Hall sensor monitors actual fan rpm and indicate when communication should take place. The MCU continuously monitors motor speed by measuring the output period of the Hall effect sensor.

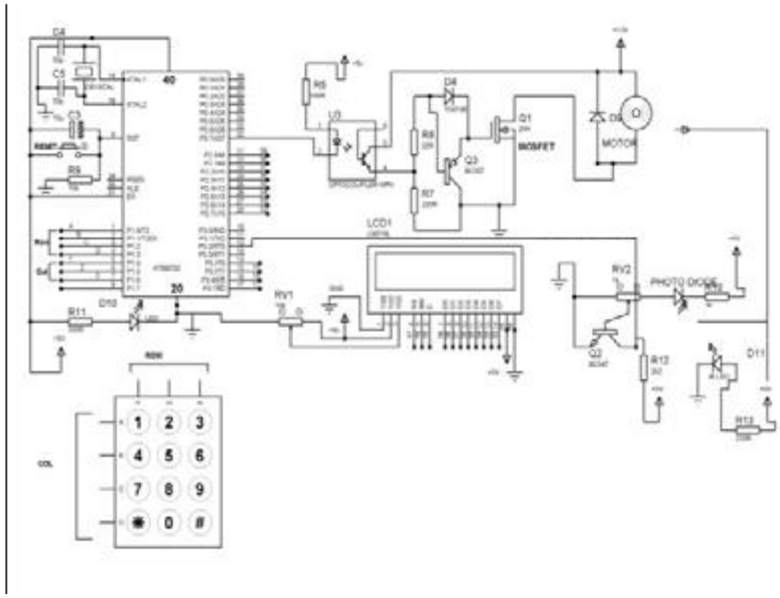
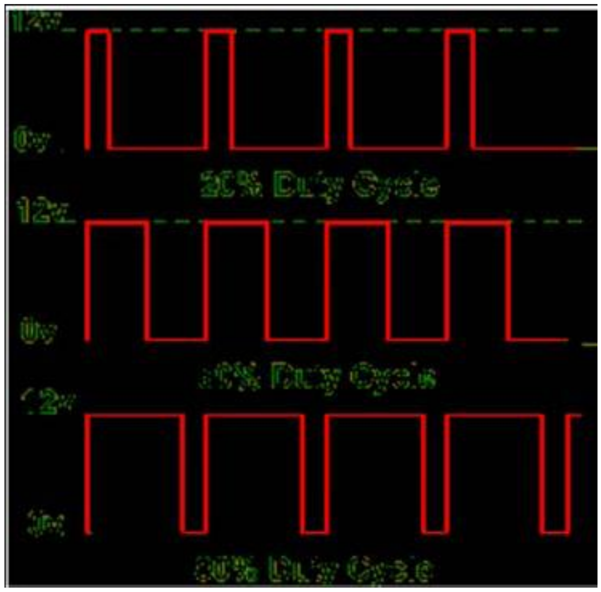


Fig 5. Schematic Diagram

IV. BLDC MOTOR SPEED CONTROL

Pulse-width modulation (PWM) is a commonly used technique for controlling power to an electrical device, made practical by modern electronic power switches. The average value of voltage (and current) fed to the load is controlled by turning the switch between supply and load on and off at a fast pace. The longer the switch is on compared to the off periods, the higher the power supplied to the load is. The PWM switching frequency has to be much faster than what would affect the load, which is to say the device that uses the power. Typically switching's have to be done several times a minute in an electric stove, 120 Hz in a lamp dimmer, from few kilohertz (kHz) to tens of kHz for a motor drive and well into the tens or hundreds of kHz in audio amplifiers and computer power supplies The term duty cycle describes the proportion of on time to the regular interval or period of time; a low duty cycle corresponds to low power, because the power is off for most of the time. Duty cycle is expressed in percent, 100% being fully on. The main advantage of PWM is that power loss in the switching devices is very low. When a switch is off there is practically no current, and when it is on, there is almost no voltage drop across the switch. Power loss, being the product of voltage and current, is thus in both cases close to zero. PWM works also well with digital controls, which, because of their on/off nature, can easily set the needed duty cycle. PWM has also been used in certain communication systems where its duty cycle has been used to convey information over a communications channel.



V. LOGICAL OPERATION OF BLDC MOTOR

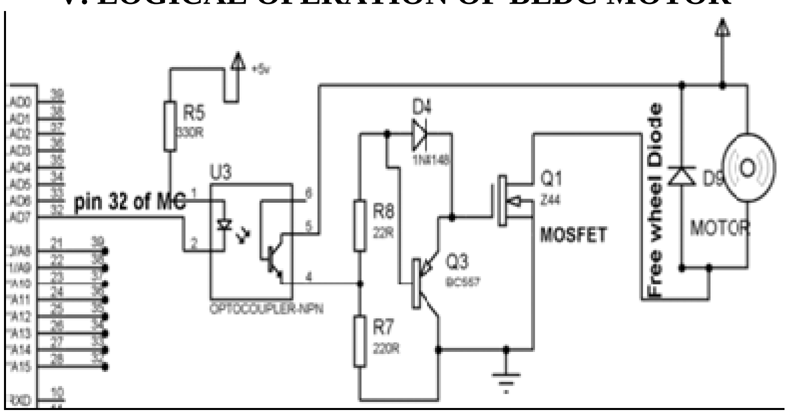
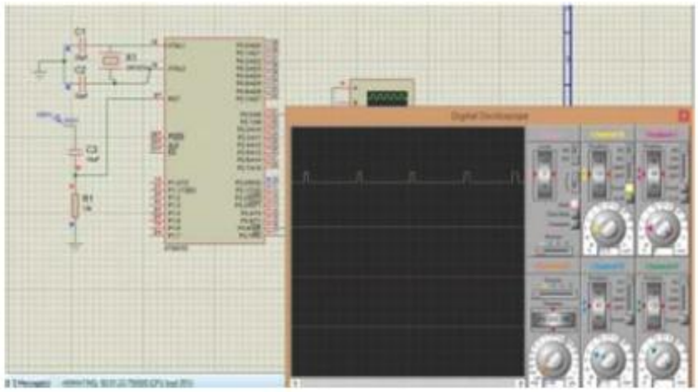


Fig.7 : PWM Generating Circuit

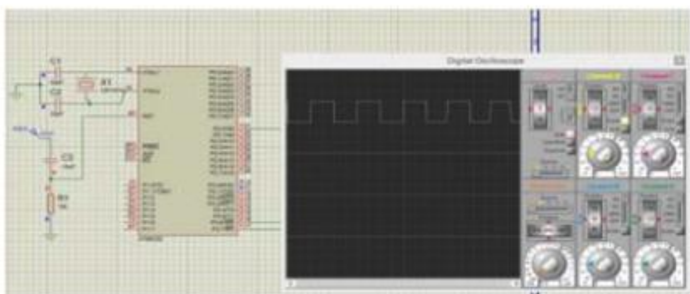
While logic high during the on time duty cycle is delivered by the microcontroller to the input of the OPTO U3 , The opto led glows to bring the opto transistor pin no 5 and 6 to conduct . Now 12V supply is given at the junction point of R7 and R8 and reaches the gate of the MOSFET Q1 via D4 for Q1 to conduct thus enabling the motor to get supply to run. A freewheel diode is used across the motor to conduct the charge stored in the motor during off period.

VI. SIMULATION RESULTS FOR VARIOUS PWM PULSES.

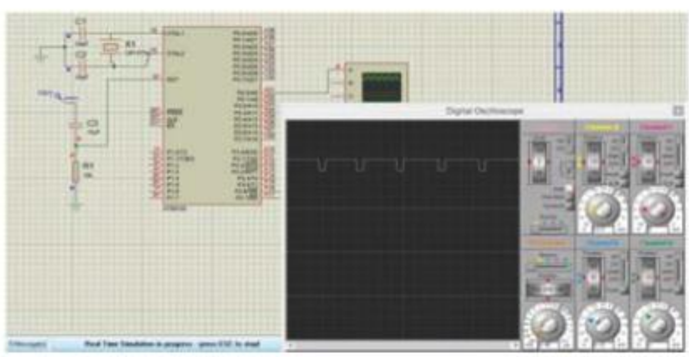
PWM Output for 20%



PWM Output for 50%



PWM Output for 80%



VI. CONCLUSION

The equipment for shut circle control of BLDC engine utilizing microcontroller is planned. By utilizing the PWM strategy speed of the BLDC engine was controlled and it was made to run at precisely entered speed. In future this equipment will be executed in dSPACE and the speed control will be noticed.

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