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### RESEARCH ARTICLE

#### ADJUSTING MOTION OF BRUSHLESS DC MOTOR THROUGH MICROCONTROLLER.

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(Brushless DC) **BLDC**, **automation**, **speed**, **Microcontroller**.

#### Abstract

The Objective of this paper is to adjust motion of Brushless DC motor through microcontroller. Now a day's every industry has become an automated industry. To make the automated industry, the machinery and equipment's should be controlled automatically. The control of machineries can be done accurately and precisely using BLDC motor. The production rate can be increased by making the automated industry. The BLDC is used in important applications as like electric vehicle, aerospace industry, actuators, and tool drives etc.

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#### Introduction:-

Due to the advantages of BLDC motor like low cost and small size, increased torque-current ratio, reduced torque ripples, high efficiency with low noises, and reduced maintenance, the applications of Brushless DC motors are increasing rapidly. By changing the duty cycle we can vary the motion of BLDC motor. The brushless DC motors, for example fans are less in weight and smaller in size than AC fans. The BLDC motors can work with the low voltage sources. It makes motor easier to use in computers, vehicles, mobile appliances, in electronic components and shaft that hold rotating, since as high efficiency, high reliability and ability to reverse rapidly. The BLDC motors are three phases which are controlled and driven by the MOSFET/ IGBT switching devices.

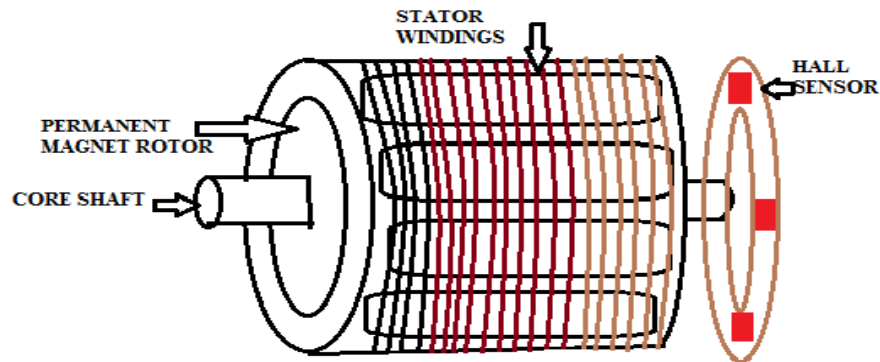
#### Problem statement and Motivation:-

Drawbacks of DC motor seem to centre on their brushes. Because of this DC motor sparks and that is why it requires maintenances periodically. The brushes of DC motor generate radio noise and interfere with TV pictures. Sparking brushes can cause explosions in mines or refineries. Brushes also wear the commutator, which needs periodic cleaning and re-machining. And, in the void of outer space, they just do not work. Hence to avoid these disadvantages the BLDC motors are used widely. Vinod KR Singh Patel [2] explains the BLDC motor drives are regularly obtaining quality in movement control applications. However, BLDC motor torque/speed regulator is efficient and effective. They are implemented in industrial and residential appliances like refrigerators. The BLDC drives are known for lower maintenance and higher efficiency. For e.g. the ceiling fan using BLDC motor requires minimum current say 0.6Amp whereas normal ceiling fan requires more than 0.6Amp current. So, the current consumption is less and maintenance required is also less.

#### Fundamentals of BLDC:-

The BLDC motor is classified in single phase and three phase configuration. The BLDC motor consists of the permanent magnet rotor and stator windings. The essential part of DC motor and universal motor are brushes and

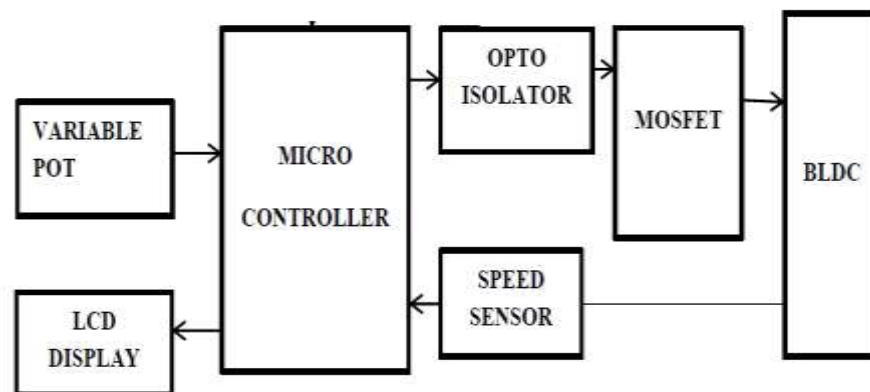
commutation ring. But, this is removed in BLDC motor design. Rather, the electronic commutation is used in BLDC motor.



**Fig 1:-**Fundamentals Of Bldc Motor

The BLDC motor is form on a basic principle of magnetism, which tells us that similar poles repulse each other, while facing poles attracts. As fig1 illustrate, it generate a magnetic field with a polarity that creates torque, when a current is passed through two coils. When a current is passed, the rotor rotates. When the rotor reaches a definite position, the direction of the current is changes so that the torque continues further in the same direction. When required the direction of current is changed again to continuous generation of torque. But, instead of two coils, actual BLDC motor typically use six coils positioned 60 degrees apart. Then, two coils at a time can be excited to create a torque enough to move the rotor to the required position. When this position is reached, other coils are energized in continuous manner producing the torque.

#### Block diagram:-



**Fig2:-**Block Diagram For Speed Controlling Of Bldc Using Microcontroller

#### Hardware description:-

##### PIC Microcontroller:-

It is the central processing unit of the system. In this operation, the microcontroller plays an important role. Output signals of Hall-effect sensors perform as external interrupts. The microcontroller makes switching device turn on and turn off alternatively.

The microcontroller responds to the interrupt based execution and changes the state of the output pin accordingly. The microcontroller gets three input signals, one from each Hall sensor, and has six output pins; one for each switching driver.

##### LCD display:-

Here we are using 16x2 LCD as the display device.

Following are its feature:

1. It can show 16 characters 1st line and 16 characters 2nd line.
2. A 330-ohm resistor is used for contrast control of LCD.
3. The LCD has three control lines of which 2 are connected to port B of the microcontroller.
4. 8 Data lines are used for transferring data from the microcontroller to LCD.
5. The LCD is used in 8-bit mode & 8 data lines are connected to port B of the microcontroller.

16x2 LCD	64x2 GLCD	TFT
Liquid crystal display	Graphic liquid crystal display	Thin film transistor
Displays characters.	Displays different graphics.	Displays image and text
Input voltage= 5V	Input voltage= 5V	Input voltage= 3.9V
Supply current=3mA	Supply current= 7.5mA	Supply Current= 10mA

**Table No.1:-** Comparison Of Lcd

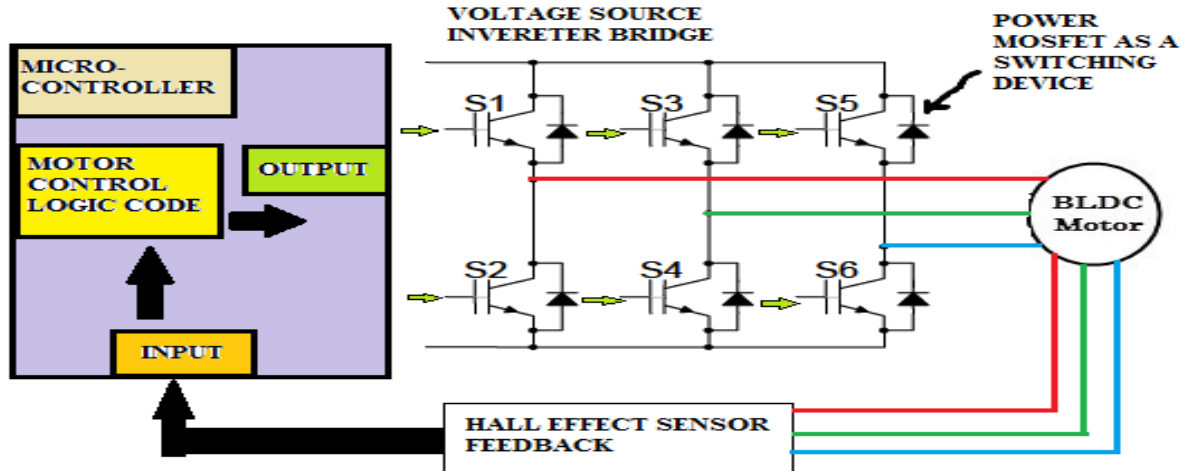
#### Optoisolator:-

Opto-isolator is a component that combines or split transmission data from optical fibers. An optoisolator which transfer electrical signals in the form of light wave there is isolation between input and output. Optoisolator prevents high voltage on one side of a circuit and damaging component on the other side of the circuit. An Optoisolator which converts electrical input signal into light.

#### Speed sensor (Hall Effect sensor):-

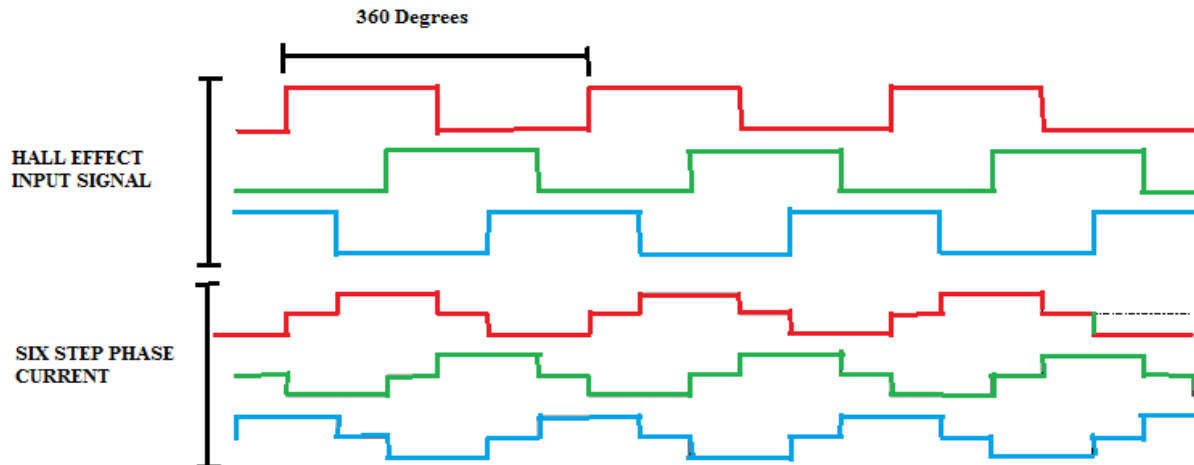
A Hall Effect is a transducer that changes its output voltage in response to a magnetic field. Hall Effect sensor is used for presence switching, speed detection, positioning and current sensing applications. It is mostly used to time the speed of wheels and shafts, such as for internal combustion engine ignition timing, tachometer and anti-lock braking systems. Hall Effect sensor used for BLDC motor for the positioning of rotor.

#### Voltage Source Inverter (VSI):-



**Fig 3:-** Voltage Source Inverter (3 Phase Configuration)

The two pole voltages of the single-phase bridge inverter generally have same magnitude and frequency but their phases are 180 degree apart. Thus the load connected between these two poles outputs between A and B will have a voltage equal to twice the magnitude of the individual pole voltage. The pole voltages of the 3 phase inverter bridge are phase apart by 120 degree each.



**Fig 4:-Six step commutation**

### Methodology:-

Pulse width modulation is a mainly used technique for controlling motion/speed of motors. The advantage of PWM is that power loss in the switching device is very low. PWM works also well with digital controls which is because of their ON/OFF nature, and can easily set the needed duty cycle. The duty cycle determines the speed of the motor. The desired speed can be obtained by changing the duty cycle. The PWM in microcontroller is used to control the duty cycle of BLDC motor.

$$\text{Average voltage} = D * V_{IN}$$

Where, D= duty cycle

$V_{IN}$ = Input voltage

### Advantages Of Bldc Motor:-

1. Lack of Brushes and physical commutator , hence sparking is not possible and maintenance is not required.
2. BLDC motor tends to be more reliable, has long life, and is more efficient.
3. BLDC having life expectations of over 10,000 hours approximately.
4. It can have speed above 10,000 RPM in the both unloaded and loaded conditions.
5. It is capable of operating with Electromagnetic Interference and higher noise than conventional brushed motors because their internal parts are completely enclosed.

### Applications Of Bldc Motor:-

1. PC cooling fan, dryers, compressors and washing machine.
2. CD/DVD players and Computer hard drives
3. Aircrafts
4. Electric vehicles, electric bicycles, and hybrid vehicles.
5. Blowers, fans and pumps.
6. Simple belt driven system, CNC machine tools and Industrial robots.

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