iJRASET
International Journal For Research in Applied Science and Engineering Technology

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 8 **Issue:** VI **Month of publication:** June 2020

DOI: http://doi.org/10.22214/ijraset.2020.6209

www.ijraset.com

Call: 08813907089 | E-mail ID: ijraset@gmail.com

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.429
Volume 8 Issue VI June 2020- Available at www.ijraset.com

Solar Powered Speed Control of Brushless DC Motor

Ms. Mrunali K. Dhole[1], Ms. Monika A. Badashah[2], Mr. Mayur B. Chaudhari[3], Mr. Sumit V. Sonawane[4], Mr. Sagar J. Patil[5], Ms. Dipali V. Patil[6]
[1, 2, 3, 4, 5]*Scholor, Electrical Engineering, GHRIEM, Jalgaon, Maharashtra, India,*
[6]*Assistant Professor, Electrical Engineering, GHRIEM, Jalgaon, Maharashtra, India,*

Abstract: Brushless DC (BLDC) motors are widely used for many industrial applications because of their high efficiency, high torque and low volume. In this project we will implement a controller to control speed of Brushless DC motor Using PWM technique, the average value of the voltage that is applied to the DC Motor is controlled by turning the power on and off at a very high rate. The frequency of this switching will be in the order of few tens of kilo Hertz. Now, the average voltage applied to the DC Motor will depend on what is called as the Duty Cycle of the PWM Signal. Duty Cycle of a PWM Signal is nothing but the ratio of the time for which the signal is ON or HIGH to the total time period of the signal i.e. sum of ON time and OFF time. Duty Cycle is usually expressed in percent and the following figure represents different PWM Signals of a 12V supply with different duty cycles of 0%, 25%, 50%, 75% and 100% respectively
Keywords: Arduino, BLDC Motor, Solar Module.

I. INTRODUCTION

In present scenario, BLDC motors are used. The BLDC motor features a kind of permanent magnetic synchronous motor. There is a lot of interest in using Brushless DC (BLDC) motors now days as it offers so many advantages as compared to the DC motor. These motors are driven by DC voltage but current commutation is carried out by solid state switches. The commutation instants are determined by the rotor Position [2]. The position of the rotor is detected either by position sensors or sensor less techniques. BLDC motors have speed and torque controls which are superior to the traditional brush-type DC motor, along with a very high level of efficiency.

The DC motors have been popular in the industry control area for a long time, because they have many good characteristics, for example: high start torque characteristic, high response performance [3], easier to be linear control…etc.

The speed of a DC motor is given be the relationship,

$$N=\frac{V-I_aR_a}{k\Phi}$$

This Equation show that the speed is dependent on the supply voltage V, the armature circuit resistance Ra, and field flux Φ, which is produced by the field current [1].

In this research work, it is proposed to design and implement a digital signal controller for the operation of BLDC motor in all the four quadrants. Emphasis has been given to the regenerative braking mode and smooth transition between the quadrants of operation. A simple and elegant approach to save energy during the regenerative braking period has been proposed. It is also aimed to study the effect of speed control of the BLDC motor with and without loads [4].

A. Objective

The objective of this project is to control the speed of BLDC motor using arduino. Four quadrant operations are also used to control the speed of brushless DC motor[1]. So that when an electric machine is required to operate (i) both as a motor and a generator and (ii) in both forward and reverse directions, it is said to be operating in the four quadrant modes of operation[1]. A motor designed for automotive use which must run in both forward and reverse directions and which must provide regenerative braking in both directions needs a four Quadrant controller.

ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.429
Volume 8 Issue VI June 2020- Available at www.ijraset.com

II. LIERATURE REVIEW

Journal of Electrical Engineering & Technology Vol. 6, No.2,pp.215,2011 on "PFC Bridge Converter For Voltage-controlled Adjustable- speed PMBLDCM Drive" by Sanjiv Singh And Bhim Singh.

In this project we will implement a controller to control speed of Brushless DC motor using PWM technique, the average value of the voltage that is applied to the DC Motor is controlled by turning the power on and off at a very high rate. The frequency of this switching will be in the order of few tens of kilo Hertz. Now, the average voltage applied to the DC Motor will depend on what is called as the Duty Cycle of the PWM Signal. Duty Cycle of a PWM Signal is nothing but the ratio of the time for which the signal is ON or HIGH to the total time period of the signal i.e. sum of ON time and OFF time. Duty Cycle is usually expressed in percent and the following figure represents different PWM Signals of a 12V supply with different duty cycles of 0%, 25%, 50%, 75% and 100% respectively.

III. METHODOLOGY

A. *Block Diagram*

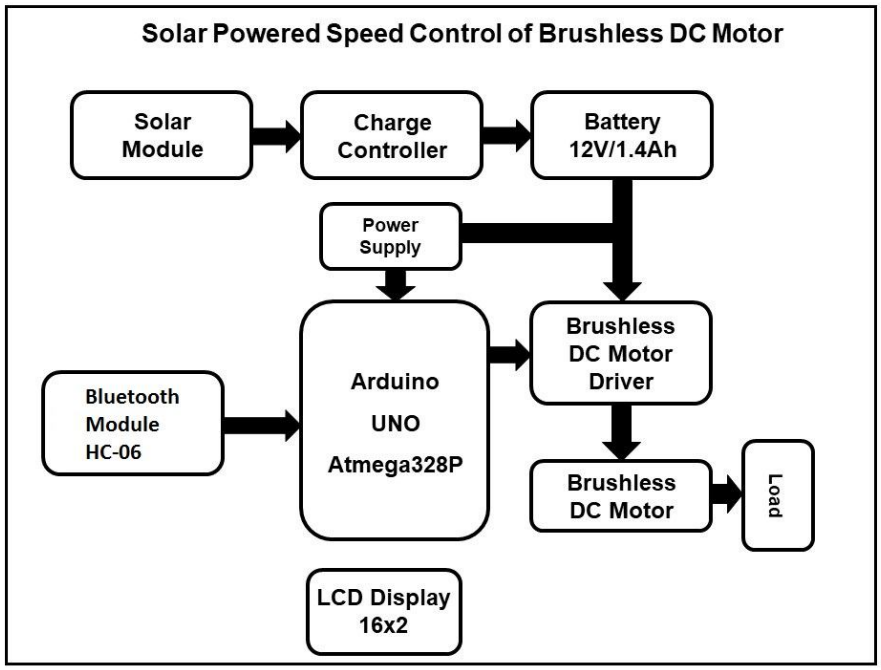


Fig.3.1:- Block Diagram Representation

1) *Solar Panel:* It is used with 2.5 watts, 5 volts and 500mah. Solar panels work by absorbing sunlight with photovoltaic cells. If conductors are attached to the positive and negative sides of a cell, it forms an electrical circuit. When electrons flow through such a circuit, they generate electricity.
2) *Battery:* Battery is used for 12 volts and 1.4Ah, which is a lead acid battery. Battery is obviously a dc component, as normally battery stores the charges.
3) *Charge Controller:* The terms "charge controller" or "charge regulator" may refer to either a stand-alone device, or to control circuitry integrated within a battery pack, battery-powered device, or battery charger.
4) *Bluetooth Module:* HC-06 is a Bluetooth module designed for establishing short range wireless data communication between two microcontrollers or systems. The module works on Bluetooth 2.0 communication protocol and it can only act as a slave device. The device works on the frequency range from 2.402 GHz to 2.480GHz
5) *PWM Technique:* Pulse-width modulation (PWM) is used for controlling the amplitude of digital signals in order to control devices and applications requiring power or electricity. It essentially controls the amount of power, in the perspective of the voltage component that is given to a device by cycling the on-and-off phases of a digital signal quickly and varying the width of the "on" phase or duty cycle. To the device, this would appear as a steady power input with an average voltage value, which is the result of the percentage of the on time. The duty cycle is expressed as the percentage of being fully (100%) on.

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.429
Volume 8 Issue VI June 2020- Available at www.ijraset.com

IV. EXPERIMENTAL SET-UP

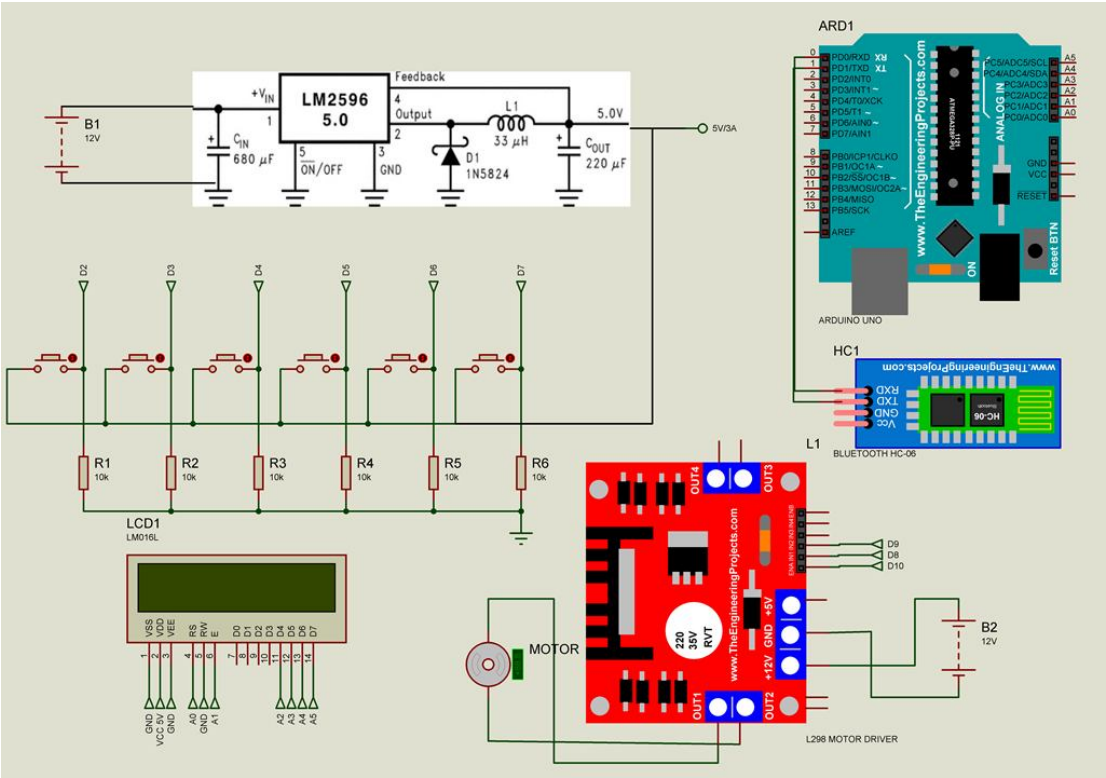


Fig.4.1 Circuit diagram of solar powered speed control of BLDC motor.

A. Circuit Diagram Explanation

The important components in this circuit diagram are Arduino, power supply, motor, motor driver, switches / buttons, Bluetooth module. SMPS has power supply. 12 volt battery is used and 12 volt 2 ampere, 6000 rpm BLDC motor is used. The motor cannot be operated through direct arduino pins. The reason is high power motor. For this you need a high power driver so that you can drive the motor with high power, high current and high voltage. This is called as a motor driver.

The signal goes to the arduino through the motor driver. L298 is the motor driver used. This will drive the motor. L298 drives 2 motors simultaneously. The motor driver has a total of 6 pins. There are 3 control signals for each motor drive. There are basically 2 control signals. That means the motor driver has a total of 6 pins. 3 pins motor 1 and 3 pins motor 2 (D8, D9, D10). 2 pins out of 3 pins of the motor are used to control the motor and uses 1pin motor to control the speed. Changing 0 to 5 volts will change the motor low to maximum speed.

Two pins (D8, D9) operation is given,

Pin D8	Pin D9	Operation
0	0	Motor Stop
0	1	Clockwise
1	0	Anticlockwise
1	1	Motor Stop

Table no. 1 Motor Operation

Bluetooth and switches are used to issue commands. Start, stop, forward motoring, reverse motoring, forward breaking, and reverse breaking. 6 switches are used for total 6 operations.

1) Switch: Motor operation can operate manually. The six switches are connected to Arduino's six digital pins. For example, if 4 out of 1 to 6 switches of arduino are pressed, the pin of 4 numbers will be ground immediately. If you program the arduino 4 number pin, it will execute the program. The function of each pin has been fixed.

2) *Bluetooth Module:* The Bluetooth module (HC-06) has a total of 4pins are VCC, ground, TXD, RXD (serial communication). The Bluetooth module will be operated through the app. It is connected to arduino. The arduino pin TX is connected to the Bluetooth Rx and the arduino pin RX is connected to Bluetooth TX. The Bluetooth operation is performed using a specific character (letter) to connect to the android app. suppose If you press A letter in mobile app, 'A' letter will be sent to Bluetooth. Then 'A' letter is sent to pin TX, RX through arduino and motor will start when signal is sent to arduino. In this circuit LCD display is connected. It will display operation and switches (character / letter) Also speed will be displayed.

B. Hardware Implementation Components

Sr no.	Components Name	Specification	Comments
1.	Arduino Uno	Atmega328P	Used to write and upload computer code to the physical board.
2.	Motor Driver	L298N/2A	Motor drivers are to take a low-current control signal and then turn it into a higher-current signal that can drive a motor.
3.	DC Motor	8000RPM	Electrical motors that converts direct current electrical energy into mechanical energy.
4.	IC	LM2596 5V	The adjustable version can take in input voltage from 4.5V to 40V and convert it to variable voltage sourcing upto of 3A of continues current.
5.	Capacitor	1000uF/25V	Its function is to store the electrical energy and give this energy again to the circuit when necessary.
6.	Capacitor	220uF/25V	Its function is to store the electrical energy and give this energy again to the circuit when necessary.
7.	Inductor	100uH/2A	Basically, it uses a conductor that is wound into a coil, and when electricity flows into the coil from the left to the right, this will generate a magnetic field in the clockwise direction.
8.	Schottky Diode	100uH/2A	It is a semiconductor diode with a very fast switching action.
9.	LED	5mm Red	LED is one of the many types of semiconductor devices that give off lights when an electric current passes through it.
10.	Resistor	1K/1/4W	The main function of resistors in a circuit is to control the flow of current to other components.
11.	LCD Display	16x2	LCD uses a liquid crystal to produce a visible image
12.	Bluetooth Module	HC-06	Bluetooth module designed for transparent wireless serial communication.
13.	Button	Push to ON	it makes the circuit connected when pressed and breaks when released.
14.	Battery	Lead Acid 1.2Ah/12V	Seal Lead Acid (SLA) Rechargeable battery is the most common general purpose battery.
15.	Boost Converter	0-40V/4A	A boost converter (step-up converter) is a DC-to-DC power converter that steps up voltage (while stepping down current) from its input (supply) to its output (load).
16.	Solar Module	6W/10V	The function of solar panels is to gather that energy and convert it to electricity to bring power to our project

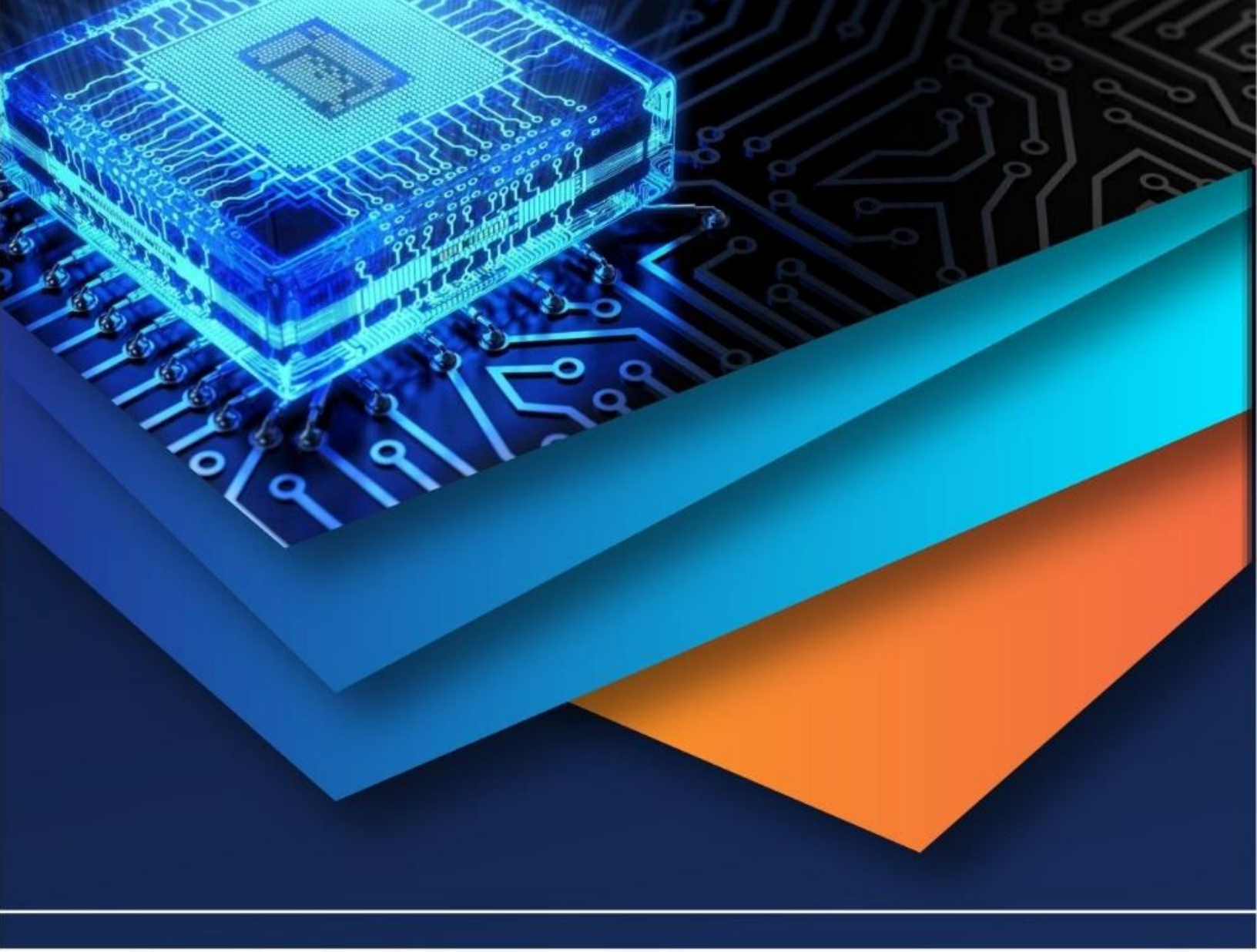
Table no.2: Components Rating & Specification

V. CONCLUSION

In this project we perform four quadrants operation i.e. forward motoring, forward breaking, reverse motoring & reverse breaking with start and stop switch. This four quadrant operations are mandatory to control the speed of motor. BLDC motor is a good choice for various applications due to higher efficiency, higher power density and higher speed ranges compare to other motor types.

REFERENCES

[1] Aditya Pratap Singh & Udit Narayan, "Speed Control of DC Motor using Pid Controller Based on Matlab", Vol.4, No.6, 2013.
[2] Ms. Snehalata Y. Dhenge,"Prof. V.S. Nandanwar, To Study Speed Control and Four Quadrant Operation of BLDC Motor", International Journal of Engineering Research and Applications , Vol. 3, Issue 2, March -April 2013, pp.733-737.
[3] NAWI BIN BERAHIM, "Developement Of PID Voltage Control For DC Motor Using Arduino", July 2014.
[4] https://shodhganga.inflibnet.ac.in/bitstream/10603/25846/6/06-chapter1.pdf
[5] http://www.electronicwings.com/arm7/hc-05-bluetooth-module-interfacing-with-lpc2148.



10.22214/IJRASET

45.98

IMPACT FACTOR: 7.129

IMPACT FACTOR: 7.429

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY