



SPEED CONTROL OF BLDC MOTOR USING ANDROID APPLICATION

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ABSTRACT:

Variable speed Brushless DC motor has wide application in present days compared to Conventional DC motor. In this article a novel method to control the speed of BLDC motor through mobile application using Bluetooth is proposed. The signal to control the BLDC motor is sent through Bluetooth which is controlled by Arduino board. Pulse width modulation (PWM) method is implemented to control the BLDC motor.

Index Terms - BLDC motors, Arduino, Android

INTRODUCTION:

DC motors were used in a wide range in all industrial and domestic application as compared to AC motor due to their good efficiency. Brushless DC motors are used instead of Conventional DC motors due to their less heat loss and good efficiency. A brushless DC motor is a permanent magnet DC motor. It uses the DC supply. A DC motor has brushes which are used to make mechanical contact with commutator on the rotor side which are used to supply the electrical supply to armature winding. In BLDC motor this operation is done by permanent magnet rotor and sequence of coils in stator.

In present days the variable speed of DC motors have major application in Industrial automation for manufacturing process such as textile, paper, robotics and also in automobile needs speed control of such motors. In the industrial side BLDC motors are used as actuators for robots. In domestic side they are used in washing machine, fans & etc.

In present days a wireless technology is used to control the motor from a distance are required to make the operation easy. Hence Bluetooth module is used to control process by wireless.

DESIGN AND IMPLEMENTATION:

1. Hardware design:

The below flow diagram fig.1 describes the flow of controlled signal sent by the android mobile to control BLDC motor. By using the scheme, the direction of rotation of DC motor can be controlled either in clockwise or anticlockwise directions by using PWM signals. These direction control reverses the current flow in armature winding of the BLDC motor.

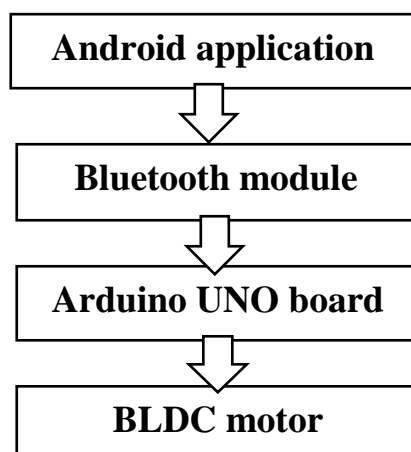


Fig.1. The schematic diagram for speed and direction control of a BLDC Motor

The Bluetooth reads the information and passes it to the Arduino UNO board .It makes changes in the speed of motor according to the user information. The direction and the PWM is displayed in the mobile.

1.1 PWM TECHNIQUE:

PWM technique is used to control the speed of the BLDC motor due to its high efficiency and easy implementation. This method is used mainly to generate square wave frequency greater than 1KHZ.

The mathematical expression for duty cycle is,

$$\% \text{ duty cycle} = (t_{\text{on}} / (t_{\text{on}} + t_{\text{off}})) * 100$$

t_{on} - on time.

t_{off} - off time.

$t_{\text{on}} + t_{\text{off}}$ - total time

The speed increases with increases in duty cycle. The input supply may analog or digital signal. At various duty cycle the waveforms generated showing are shown in Fig.2

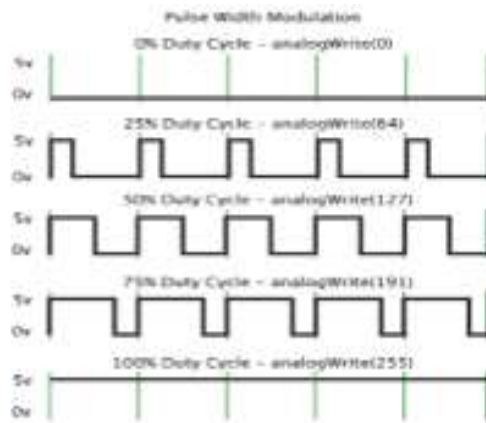


Fig.2 Pulse Width Modulation

HARDWARE COMPONENTS:

The mainly used hardware components are Arduino UNO (ATmega328 microcontroller), Bluetooth module(HC-05; range=10m),Android based smartphone, connecting wires, soldering materials, breadboard, plastic toy fan, BLDC motor (0.35W, 6V-12V).

A.ARDUINO UNO

ATMEGA328 Microcontroller Arduino UNO board is used. It consists of fourteen pins. Six pins are used to get PWM output. It consists of ICSP header, 6 Analog pins, power jack, quartz crystal pf frequency 16 MHz, USB connector and reset button.

This board can work on any operating system example Windows, LinuxPower supply can be given to the board via USB[15-18].



Fig. 3. Arduino UNO Module

The specifications of Arduino Uno are-

ATmega328 Microcontroller
Optimum Voltage: 5V
i/p Voltage: 7 to 12V
i/p Voltage: 6 to 20V
Input/output pins(Digital): fourteen

Analog Pins: six

Current per I/O Pin: 39 mA, DC

Current for 3.3V Pin: 49 mA, DC

Flash Memory: 32 kB

SRAM: 2 kB (ATmega328)

EEPROM: 1 kB (ATmega328)

Speed of clock 16 MHz

High performance 8bit microcontroller

B. Bluetooth Module (HC05)

Bluetooth HC05 module is used for wireless, transparent communication. Master/Slave configuration module is used for better solution in wireless communication. The module is a Bluetooth V2.0 with EDR. Also it has a 2.4Ghz baseband and transceiver.



Fig. 4. Bluetooth Module HC05

The specifications of Bluetooth Module are-

Bluetooth Version: V2.0 EDR

Modulation: GFSK

Frequency: 2.4GHz

Dissipated power: ≤ 4 dBm

Sensitivity: ≤ -84 dBm

Speed: Synchronous: 1Mbps/1Mbps

Asynchronous: 2.1Mbps(Max)/160 kbps Security: Encryption and Authentication

Input Current and Voltage : 50mA, 3.3 VDC

Dimension: 27mm x 13mm x 2mm

Working temperature: $-15 \sim 75$ Centigrade

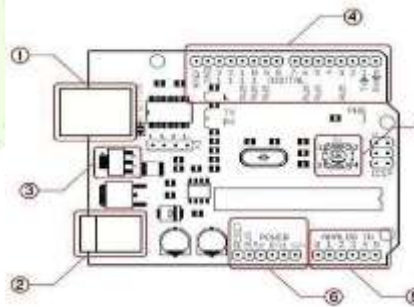


Fig. 5 . Pin Diagram of Arduino UNO

Hardware Features

fSensitivity -80dBm

RF transmits power up to +4dBm.

Input/output can be controlled by programming.

Software Features

Data bits:8, Stop bit:1, Default Baud rate: 9600, No parity.

Default auto-pairing PINCODE:"1234"

C.Brushless DC Motors

Brushless DC motor does not have any brushes. these motors are capable of producing high torques efficiently. In these motors there are permanent magnets rotating around a stationary armature. By using this permanent magnet current to the armature has been fed. These BLDC motors are used widely due to their smooth operation.



Fig. 6 . Brushless DC Motor

Some of the advantages of BLDC Motors are-

High Rotating Speed – BLDC motors are able to operate at speeds above 11,000 rpm under both loaded condition and unloaded condition.

They can be accelerated and decelerated quickly due to low inertia.

High Power – BLDC motors have the high running torque per inch cube as compared to any DC motor.

High Reliability – Absence of brushes results in more reliable and higher life expectancies of over 11,000 hours.

BLUETOOTH APPLICATION

Android Studio application is used. “Blue Terminal” is the main application used in this work. This Arduino studio used to connect the Bluetooth and control the speed of motor. The application works on 7 modes.

Encryption and programming were used to create this application. The application is just a switching system which will be executed via Bluetooth. Kernel is brought to the memory by boot loader. It works properly when the data required is given. The kernel can easily adapt if we change the surroundings. Kernel is a program which manages the input/output requests. The proposed work is having several advantages over the existing techniques available. Some of them-Energy Efficient, Eco-Friendly, Cannot be Hacked, Controlled via Android based Mobile.

SOURCE CODE FOR BLUETOOTH INTERFACE AND MOTOR CONTROL

```
#include <Servo.h>

Servo myservo;

void setup() {
  Serial.begin(9600);
  myservo.attach(12);
  myservo.write(30);
  delay(3000);
}

void loop() {
  if(Serial.available(>0)
  {
  char data=Serial.read();

  int motor_speed;

  switch(data)
  { case'1': {myservo.write(50);motor_speed=50;
  break;}
  case'2':
  {myservo.write(75);motor_speed=75;
  break;}
  case'3':
  {myservo.write(80);motor_speed=80;
  break;}
  case'4':
  {myservo.write(85);motor_speed=85;
```

```

break;}

case'5':

{myservo.write(90);motor_speed=90;

break;}

case'6':

{myservo.write(100);motor_speed=100;

break;}

case'7':

{myservo.write(110);motor_speed=110;break;}

case'8':

{myservo.write(120);motor_speed=120;break;}

case'9':

{myservo.write(130);motor_speed=130;break;}

default:break;

}

Serial.println(data);

Serial.print("HC 05 value recieved=");

Serial.println(motor_speed);

}

delay(50) } }

```

RESULT:

The different speeds with reversal of rotational direction are achieved with the help of proposed scheme. For the various inputs the results obtained are tabulated in Table I. Depending upon the input values (0, 1, 2, 3...6) and duty cycle (0, 50, 75 and 100%), the desired direction of rotation (clockwise / anticlockwise) and speed control (0, 33 and 60 rpm) have been obtained.

Input	Command	Speed	Voltage
1	Motor Clockwise	0	0.07V
2	Motor Clockwise	33 rpm	0.70V
3	Motor Clockwise	60 rpm	1.36V
4	Motor Anti Clockwise	0	0.07V
5	Motor Clockwise	33rpm	0.7V
6	Motor Anti Clockwise	60rpm	1.36V
0	Motor Off	0	0

Table I. Results

CONCLUSION

In this project, the direction and speed control of BLDC motor has been achieved by using Arduino UNO through Bluetooth by the PWM technique. While the duty cycle is vary as the voltage also vary. these process also used for various control of BLDC motor by using remote application.

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