SPEED CONTROL OF BLDC MOTOR BY USING IOT

[1]T.Sravani,[2]O.Sandeep Kumar Reddy,[3]M.Usha Rani,[4] S.Sravanth Kumar Reddy.

[1] B.Tech Student,[2]Student,[3]Student,[4] Student
[1]Department of Electrical & Electronics Engineering,
[1]Annamacharya Institute of Technology & Sciences, Rajampet, India.

Abstract :In most of the public places electricity is being wasted as most of the common people do not think of switching off the electricity when they leave the places. Examples: offices, schools, colleges, railway stations and so on. Proposed system monitor the presence of people by means sensing the heat released from the human body. As long as the people exist in the area power to the area will be made available. Once the system detects no people exists after a delay time it switches off the electricity to save the energy.

***IndexTerms* - Robot, Sensor, MyRio, LabVIEW.**

I. INTRODUCTION

Brushless motors have only decades of history. They have been gaining attention from various industrial and household appliance manufacturers because of its high efficiency, high power density and low maintenance cost, silent operation, compact form and reliability. Recently, permanent magnet brushless dc motors are widely used in many applications such as motors, sensors, actuators, etc. Permanent magnet motors with trapezoidal back EMF and sinusoidal back EMF have several advantages over other motor types.

Most notably (compared to dc motors) they are lower maintenance due to the elimination of the mechanical commutator and they have high-power density which makes them ideal for high torque to weight ratio applications. Compared to induction machines, they have lower inertia allowing for faster dynamic response to reference commands. Also, they are more efficient due to permanent magnets which results in virtually zero rotor losses. Permanent magnet brushless DC (PMBLDC) motors could become serious competitors to the induction motor for servo applications.

The PMBLDC motor is becoming more popular because of its high efficiency, high power factor, high torque, simple control and lower maintenance. The major disadvantage with permanent magnet motors is their higher cost and relatively higher complexity introduced by the power electronic converter used to drive them. The added complexity is evident in the development of torque/speed regulator.

High efficiency, high power density and wide range speed controllability of BLDC motors make them suitable in various drive applications. In particular the spindle motors used in computer hard disk drives are to possess high speed characteristics for fast data access..

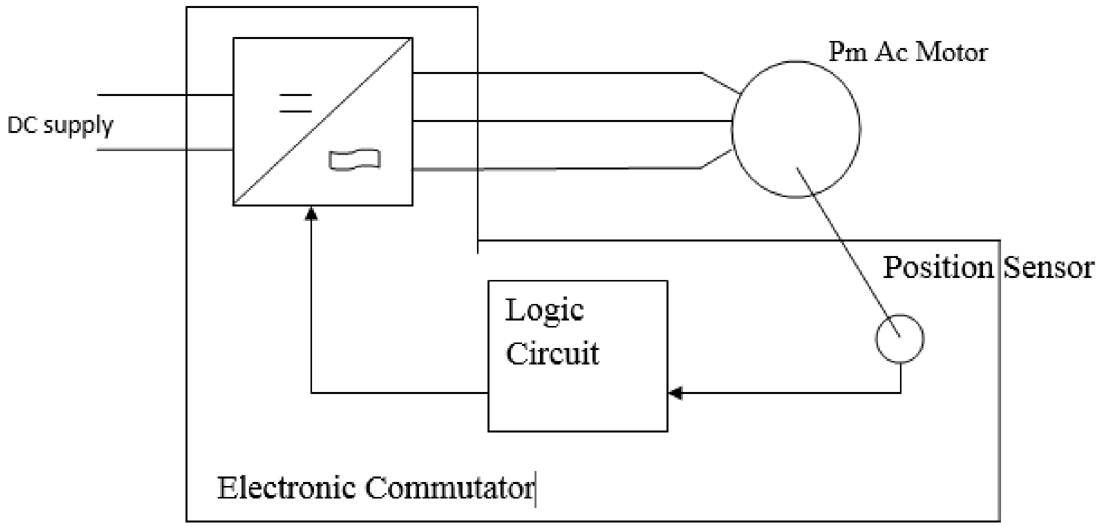

Fig.1.1.BLDC Motor Drive system

Basically BLDCMs are equivalent to the Permanent Magnet AC Motors except one difference the Hall Sensor. Brushless Direct Current (BLDC) motors are one of the motors types' rapidly gaining popularity. BLDC drive system is shown in Fig.1.1.

BLDC motors are used in industries such as Appliances, Automotive, Aerospace, consumer, Medical, Industrial

Automation equipment and Instrumentation. As the name implies, BLDC motors do not use brushes for commutation; instead, they are electronically commutated.

BLDC motors have many advantages over brushed dc motors an induction motors. A few of these are:
Better speed versus torque characteristics
High dynamic response
High efficiency
Long operating life
Noiseless operation
Higher speed ranges

II. CONTROL SCHEMES

For the past two decades several Asian countries such as Japan, which have been under pressure from high energy prices, have implemented variable speed PM motor drives for energy saving applications such as air conditioners and refrigerators. On the other hand, the U.S.A. has kept on using cheap induction motor drives, which have around 10% lower efficiency than adjustable PM motor drives for energy saving applications.

Therefore recently, the increase in energy prices spurs higher demands of variable speed PM motor drives. Also, recent rapid proliferation of motor drives into the automobile industry, based on hybrid drives, generates a serious demand for high efficient PM motor drives, and this was the beginning of interest in BLDC motors.

BLDC motors, also called permanent magnet DC synchronous motors, are one of the motor types that have more rapidly gained popularity, mainly because of their better characteristics and performance. These motors are used in a great amount of industrial sectors because their architecture is suitable for any safety critical applications.

The brushless DC motor is a synchronous electric motor that, from a modeling perspective, looks exactly like a DC motor, having a linear relationship between current and torque, voltage and rpm. It is an electronically controlled commutation system, instead of having a mechanical commutation, which is typical of brushed motors. Additionally, the electromagnets do not move, the permanent magnets rotate and the armature remains static. This gets around the problem of how to transfer current to a moving armature.

In order to do this, the brush-system commutator assembly is replaced by an intelligent electronic controller, which performs the same power distribution as a brushed DC motor. BLDC motors have many advantages over brushed DC motors and induction motors, such as a better speed versus torque characteristics, high dynamic response, high efficiency and reliability, long operating life (no brush erosion), noiseless operation, higher speed ranges, and reduction of electromagnetic interference (EMI). In addition, the ratio of delivered torque to the size of the motor is higher, marking it useful in applications where space and weight are critical factors, especially in aerospace applications.

The control of BLDC motors can be done in sensor or sensor less mode, but to reduce overall cost of actuating devices, sensor les control techniques are normally used. The advantages of sensor less BLDC motor control is that the sensing part can be omitted, and thus overall costs can be considerably reduced. The disadvantages of sensor less control are higher requirements for control algorithms and more complicated electronics.

The PMs can be surface mounted on the rotor (SMPM) or installed inside of the rotor (IPM), and the back-EMF shape can either be sinusoidal or trapezoidal. According to the back-EMF shape, PMAC synchronous motors (PMAC or PMSM) have sinusoidal back-EMF and BLDC motors (BLDC or BPM) have trapezoidal back-EMF.

A PMAC motor is typically excited by a three phase sinusoidal current, and a BLDC motor is usually powered by a set of currents having a quasi-square waveform. Because of their higher power density, reliability, efficiency, maintenance free nature and silent operation, permanent magnet (PM) motors have been mostly used in a variety of applications in industrial automation, computers, aerospace, military (gun turrets drives for combat vehicles), automotive(hybrid vehicles) and household products. However, the PM BLDC motors are inherently electronically controlled and require rotor position information for proper commutation of currents in its stator windings.

It is not desirable to use the position of sensors for applications where reliability is of utmost importance because a sensor failure may cause instability in the control system. These limitations of using position sensors combined with the availability of powerful and economical microprocessors have spurred the development of sensor less control technology. Solving this problem effectively will open the way for full penetration of this motor drive into all low cost, high reliability, and large volume applications.

III IOT Based BLDC Motor Control

The BLDC Motor has been widely used in industries because of its properties such as high efficiency, reliability, high weight to torque ratio. The BLDC drive systems are often used in many industrial applications such as robotics, actuation and manipulators.

The Internet of Things (IoT) refers to the ever growing network of physical objects that feature an Internet protocol (IP) address for internet connectivity and the communication that occurs between these objects and other internet enabled devices and systems.

By utilizing this IoT control, the rate can be tuned until it gets like the desired output. The IoT allows objects to be sensed or controlled remotely across existing network infrastructure, creating opportunities for more direct integration of the physical world into computer based systems, and resulting in improved efficiency, accuracy and economic benefit in addition to reduced human intervention.

This concept implements a speed control system which displays the speed according to our requirements which helps the users to detect the speed whether the motor is running at the required constant speed or not.

Hardware consists of Fuses, PLC, RFID wireless receiver, bulb, Dc motor, Ac contactor, Rectifier, Auto/manual switch and Indicator. If the hardware is working under Auto mode the PIR motion detection sensor starts sensing the human motions and if any motion detects it sends a signal to the RFID wireless receiver, this RFID send status High signal to PLC. According logical inputs to the PLC the output is controlled. In this mode the Indicator starts blinking (1sec ON & 1sec OFF) i.e. the circuit is operating under Auto mode.

3.1 BLDC Motor

A brushless DC motor (known as BLDC) is a permanent magnet synchronous electric motor which is driven by direct current (DC) electricity and it accomplishes electronically controlled commutation system (commutation is the process of producing rotational torque in the motor by changing phase currents through it at appropriate times) instead of a mechanically commutation system. BLDC motors are also referred as trapezoidal permanent magnet motors.

Unlike conventional brushed type DC motor, wherein the brushes make the mechanical contact with commutator on the rotor so as to form an electric path between a DC electric source and rotor armature windings, BLDC motor employs electrical commutation with permanent magnet rotor and a stator with a sequence of coils. In this motor, permanent magnet (or field poles) rotates and current carrying conductors are fixed.

The armature coils are switched electronically by transistors or silicon controlled rectifiers at the correct rotor position in such a way that armature field is in space quadrature with the rotor field poles. Hence the force acting on the rotor causes it to rotate. Hall sensors or rotary encoders are most commonly used to sense the position of the rotor and are positioned around the stator. The rotor position feedback from the sensor helps to determine when to switch the armature current.

This electronic commutation arrangement eliminates the commutator arrangement and brushes in a DC motor and hence more reliable and less noisy operation is achieved. Due to the absence of brushes BLDC motors are capable to run at high speeds. The efficiency of BLDC motors is typically 85 to 90 percent, whereas as brushed type DC motors are 75 to 80 percent efficient. There are wide varieties of BLDC motors available ranging from small power range to fractional horsepower, integral horsepower and large power ranges.

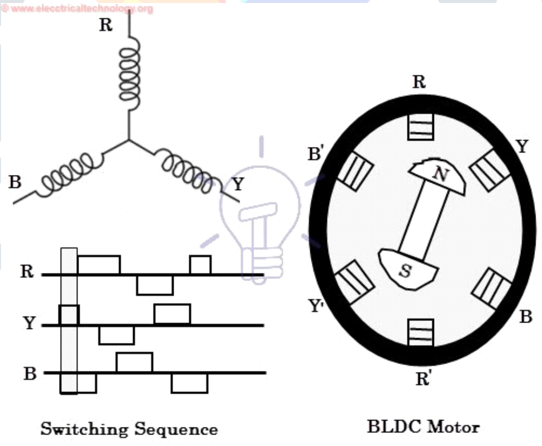

Fig.3.1.1. BLDC Rotor, Switching sequence

3.2 ESP8266

The ESP8266 is a low-cost Wi-Fi chip with full TCP/IP stack and MCU (microcontroller unit) capability produced by Shanghai-based Chinese manufacturer, Espressif Systems.

The chip first came to the attention of western makers in August 2014 with the ESP-01 module, made by a third-party manufacturer, Ai-Thinker. This small module allows microcontrollers to connect to a Wi-Fi network and make simple TCP/IP connections using Hayes-style commands. However, at the time there was almost no English-language documentation on the chip and the commands it accepted.

The very low price and the fact that there were very few external components on the module which suggested that it could eventually be very inexpensive in volume, attracted many hackers to explore the module, chip, and the software on it, as well as to translate the Chinese documentation. The ESP8285 is an ESP8266 with 1 MB of built-in flash, allowing for single-chip devices capable of connecting to Wi-Fi.The successor to these microcontroller chips is the ESP8266.

An ESP8266 microcontroller made express it is loaded with features. The most important being WIFI. The best part is that they are dirt cheap and more powerful than an arduino. There is a variety of programming resources for these chips. It can operate at a supply voltage of 3.3volts. It is a chip with which manufactures make wireless microcontroller modules. It is a low cost, networkable foundation for facilitating IoT development.

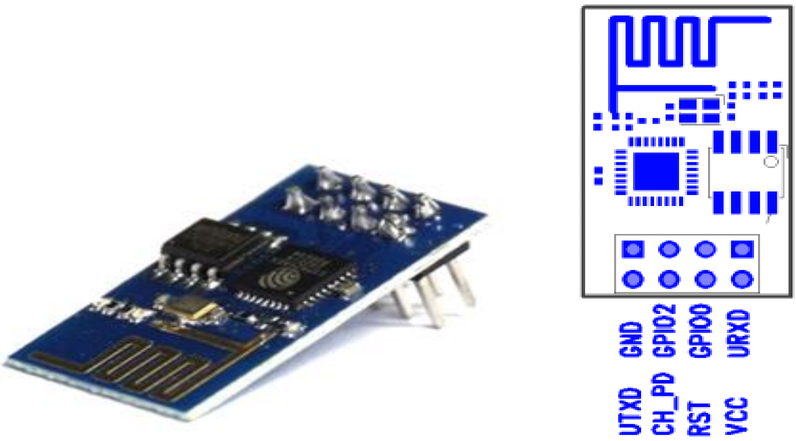

Fig.5.3.ESP8266 Architecture

3.3 Motor Driver

Motor drivers portfolio offers integrated drivers with simple control interface and smart gate drivers. These devices leverage advanced on-chip control algorithms and startup, anddiagnostic and protection features that allow system designers to maximize motor performance at low cost. MotorDriver are primarily used in autonomous robotics only.

Also most microprocessors operate at low voltages and require a small amount of current to operate while the motors require a relatively higher voltages and current Thus current cannot be supplied to the motors from the microprocessor. This is the primary need for the motordriver. The L293 and L293D devices are quadruple high current half-H drivers. These are designed to drive inductive loads Such as relays, solenoids, stepper or dc motors.

Fig.3.3.1.Motor Driver

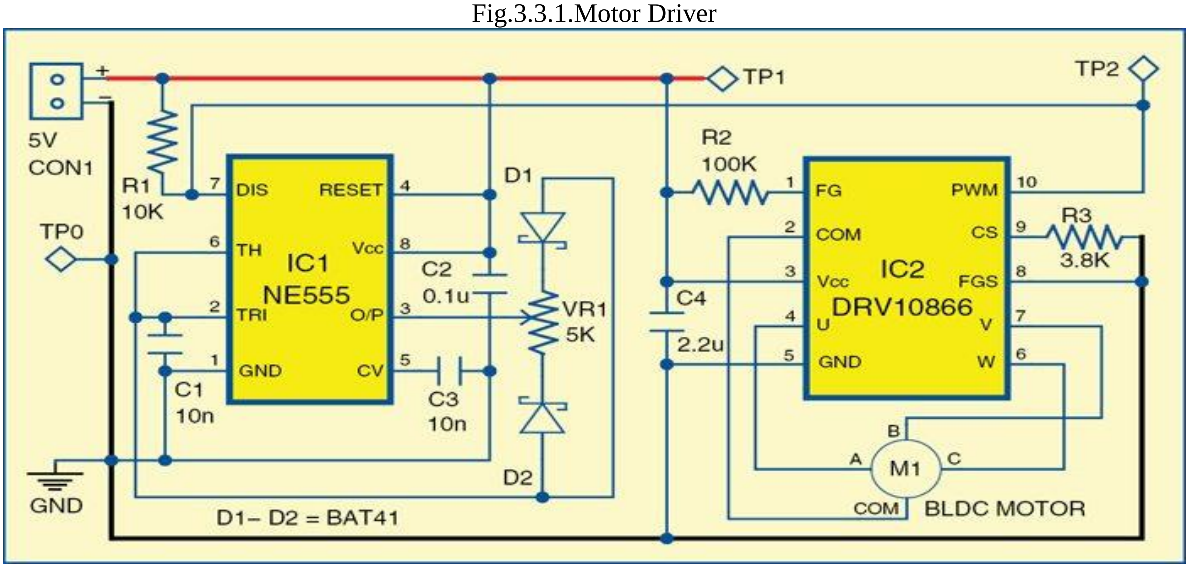

Fig.3.3.2 Motor driver internal Architecture

IV Results

The speed details are sent to cloud with the help of Wi-Fi module which will be then updated on the WifiMcu application. Here we can be monitoring the speed according to our desire. The below figure shows the WifiMcu application interface monitoring and control screen.

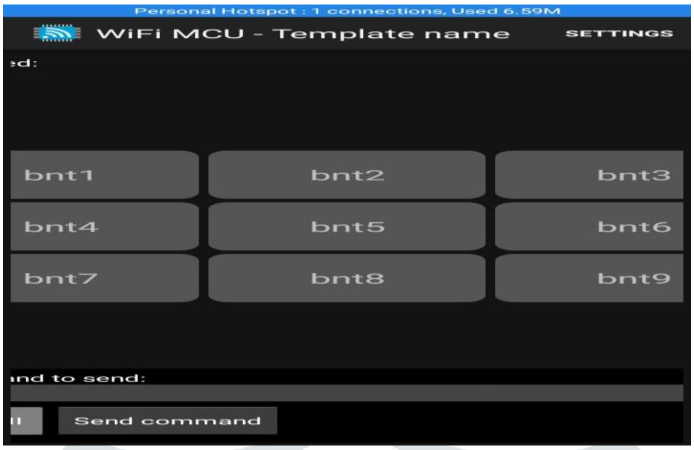

Fig.4.1.WifiMcu setting

All settings are configured in the app as per our requirement. Here only buttons 1, 2 and 3 are used as per our requirement. Remaining are unnecessary.

Fig.4.2.btn1 for switch on the motor

After all the settings had done one can press button 1 for first time then motor will come to on position and it was displayed in the Lcd display as shown in the above figure 4.2. Here it was displaying motor is on and showing initial speed as 90 rpm.

Fig.4.3.btn2 for speed increase

If we press button 2 after the starting of the motor, the motor will runs at an increased speed because button 2 is meant for speed increment. Initially the speed was 90 rpm at the time of starting but after pressing button 2 the speed increases to 110 rpm.

Speed can be increased in stepwise manner i.e. 10 rpm for each tapping of the button 2. The increased speed will displayed on the LCD display as shown in the above figure 4.3.

Fig.4.4.btn3 for speed decrease

If we press button 3 after the increment in speed of the motor, the motor will runs at a decreased speed because button 3 is meant for speed decrement. Initially the speed was 110 rpm before but after pressing button 3 the speed decreases to 100 rpm. Speed can also be decreased in stepwise manner i.e. 10 rpm for each tapping of the button 3. The decreased speed will displayed on the LCD display as shown in the above figure 4.4.

Fig.4.5.btn1 for switch off the motor.

After all the operations i.e. increment or decrement had done one can press button 1 for second time then motor will come to off position and it was displayed in the LCD display as shown in the above figure 4.5.

V. Conclusion

In this project, proposed the new architecture for control the BLDC motor which uses a flexible industrial based Android smart phone at a reasonable price and implemented by Ethernet shield and Arduino as well as using web domain for system control configuration. The proposed architecture is used in a web services for communication between the remote user and the industrial device. All Android based smart phone, the Ethernet shield connection is the support built, and the industry access device to control can use the phone, 3G or 4G to access the Web page on hosting server using Android App or web domain.

VI. Acknowledgment

The authors convey deep sense of gratitude to the management of Annamacharya Institute of Technology and Sciences for helping with required facilities to complete this work.

References

[1] H. Li, G. W. Rosenwald, J. Jung, and C. Liu, "Strategic power infra-structure defense," Proc. IEEE, vol. 93, no. 5, pp. 918–933, May 2005.

[2] P. Zhang, F. Li, and N. Bhatt, "Next-generation monitoring, analysis, and control for the future smart control center," IEEE Trans. Smart Grid, vol. 11, no.2, pp. 186–192, Sep. 2010.

[3] V.C. Gungor and F. C. Lambert, "A survey on communication net-works for electric system automation," Comput. Netw., vol. 50, no. 7, pp. 877–897, May 2006.

[4] P. Ramachandran, V. Vittal, and G. T. Heydt, "Mechanical state estimation for overhead transmission lines with level spans," IEEE Trans. Power Syst., vol.23, no. 3, pp. 908–915, Aug. 2008.

[5] S. Malhara and V. Vittal, “Mechanical state estimation of overhead transmission lines using tilt sensors,” IEEE Trans. Power Syst., vol. 25, no. 3, pp. 1282–1290, Aug. 2010.**[6]** Joshue Perez, Fawzi Nashashibi, Benjamin Lefaudeux, Paulo Resende, Evangeline Pollard, "Autonomous Docking Based on Infrared System for Electric Vehicle Charging in Urban Areas", Sensors, pp. 2645-2663, January 2013.

[6] R.Nagarajan, R.Yuvaraj, V.Hemalatha, S.Logapriya, A.Mekala and S.Priyanga,"Implementation of PV - Based Boost Converter Using PI Controller with PSO Algorithm, "International Journal Of Engineering And Computer Science (IJECS), Volume 6, Issue 3, pp. 20479-20484, March 2017.

[7] J. Ausen, B. F. Fitzgerald, E. A. Gust, D. C. Lawry, J. P. Lazar, and R. L. Oye, “Dynamic thermal rating system relieves transmission con-straint,” in Proc.IEEE 11th Int. Conf. Transm. Distrib. Construction, Oper, Live-Line Maintenance (ESMO), Oct. 15–19, 2006.

[8] V.C. Gungor, L. Bin, and G. P. Hancke, “Opportunities and challenges of wireless sensor networks in smart grid,” IEEE Trans. Ind. Electron., vol. 57, no.10, pp. 3557–3564, Oct. 2010.

[9] R.Nagarajan and M, Saravanan. “Performance Analysis of a Novel Reduced Switch Cascaded Multilevel Inverter,” Journal of Power Electronics, Vol.14, No.1, pp. 48-60. 2014.

[10] S.Ullo, A. Vaccaro, and G. Velotto, “The role of pervasive and coop¬erative sensor networks in smart grids communication,” in Proc. 15th IEEE Mediterranean Electrotech. Conf. (MELECON), pp. 443–447. Apr. 26–28, 2010.