Speed & Direction Control of DC Motor through Bluetooth HC-05 Using Arduino

Asst. Prof. S.Md. Mazhar Ul Haq, Mohammad Mujahid, Mir Naser Ali Khan, Syed Abdul Farhan
Department of Electrical & Electronics Engineering,
ISL Engineering College,
Bandlaguda, Hyderabad, India.
mazhar.smd@gmail.com

Abstract- **The technology is a process that never ends and to improve the quality of any product these technologies are required. Under this article, the blueprint and execution of a cheap, robust as well as resilient and secure Bluetooth based device DC motor is present. The blueprint is represented on AT Mega 328 board and the motor is liaisons to the input/output ports. The connection between the controlling device and the Arduino Nano is without wire i.e. wireless due to which an individual can operate easily who are using Bluetooth devices. Due to low cost of this system, DC motor to be controlled with the help of this board.**

Keywords- **Dc Motor, Arduino Nano BT AT Mega 328, Bluetooth Hc-05, Motor Driver L293d**

I. INTRODUCTION

Speed control of any engine is constantly done by Pulse Width Modulation, contracted as PWM. Generation of PWM can be achieved by using Arduino. This pulse is then given to L298 Enable Pin to controls the motor speed. The type of the digital signal is basically describes by it. By using microcontroller's digital PWM output, this system can control the simple circuits effectively.

In this system we can get simple outcomes with the advanced means. Computerized control is utilized to make square wave. This example can fluctuate voltages between full on i.e. 5V and full off i.e. 0V. The length of on time i.e. at the point when the flag is available is known as Pulse Width [1].

The time taken by a system to operate is basically proportion to the term which is Duty cycle. Duty cycle is expressed in terms of percentage and that is out of 100 seconds; if rotation of motor occurs for 1 second then it duty cycle is shown as 1% or as 1/100.

For Arduino programming coding the charge simple Write (255) demonstrates the most extreme i.e. 100% obligation cycle. To accomplish half obligation cycle we need to refresh this charge to simple Write (127). Arduino UNO's stick no 3, 5, 6, 10 and 11 are utilized as PWM pins. In this undertaking we can control the speed of the DC engine by giving high and low voltages to the empower stick of the engine control driver L298.

This can be understand by following phenomenon that if the rotation of a motor occurs at the maximum speed and 100% duty cycle at 12V and then if we provide 6V supply then it will rotate with the half of the maximum speed

having 50% duty cycle [2-3]. Figure 1 shows the different PWM waves.

Another device which is essential for controlling the motor is Bluetooth module HC-05. Because of its design for transparent wireless serial connection setup, HC05 module is used due to easiness to operate Bluetooth SPP (Serial Port Protocol) module.
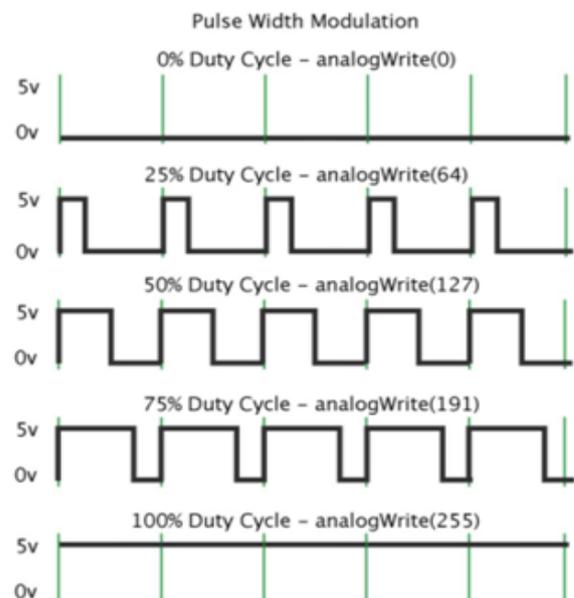

Fig 1. PWM cycle along with for percentage duty cycle.

Due to Master or Slave configuration, the HC-05 Bluetooth Module is use which making it a great solution for wireless communication. This serial port Bluetooth module is suitable by having Enhanced Data Rate of Bluetooth V2.0+and Modulation speed of 3Mbps with

complete radio transceiver and baseband of 2.4 GHz. Bluetooth system having CSR Blue core chip with CMOS technology coordinated AFH is used in this module.

It comprises of two fundamental equipment segments: the wireless and the Arduino BT board. The mobile phone empowers the client to get to the task additionally the control summons. This Python content speaks with the Arduino BT barricade and sets a specially appointed correspondence convention between the two gadgets, which permits controlling the conduct of the Arduino BT board.

Fig 2 demonstrates the Bluetooth module HC-05 is a MASTER/SLAVE module. As a matter of course the manufacturing plant setting is SLAVE. The Role of the module (Master or Slave) can be arranged just by AT COMMANDS.

The slave modules can't start an association with another Bluetooth gadget, however can acknowledge associations. To start a connection to other devices Master module is used. For such an embedded project the one can use it for a replacement of serial port to establish connection among GPS, MCU and PC etc. B.

Arduino Nano BT-AT mega 328 As the point of view of discussion about Arduino Nano, we might say that it is compact in size, complete and friendly for bread board based on the ATmega-328 (Arduino Nano 3.0) or ATmega-168 (Arduino Nano 2.x). Here we tend to understand about Arduino Nano ATmega328 for our project purpose.

The pin diagram of ATmega-328 is shown in Fig 3. The difference between this Arduino and other Arduino is that it does not have a DC control jack and works with a Mini-B USB link rather than a standard one.
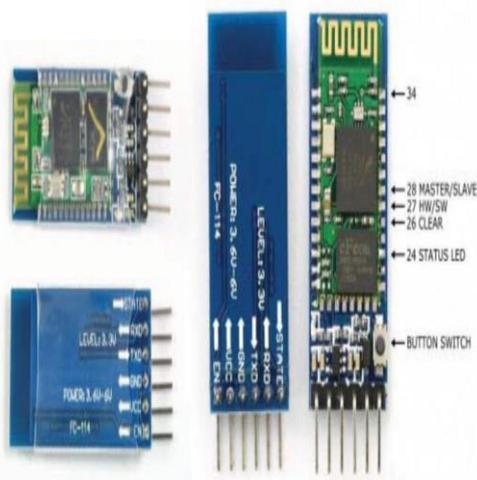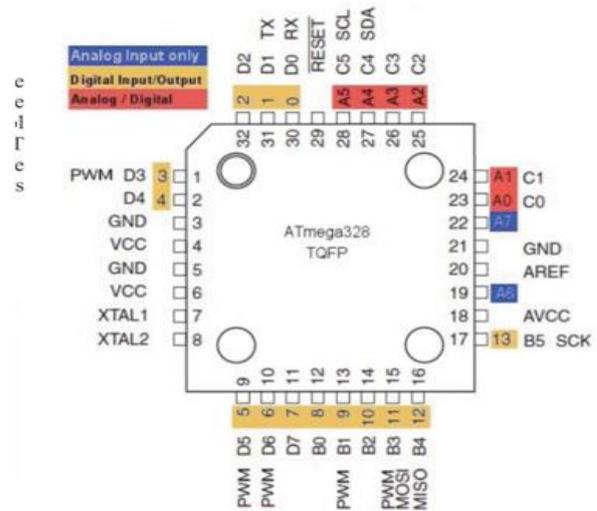

Fig 2. Bluetooth modules HC-05.

Fig 3. Pin description of AT mega 328.

II. POWER SUPPLY

All digital circuits require regulated power supply. in this article we are going to learn how to get a regulated positive supply from the mains supply.
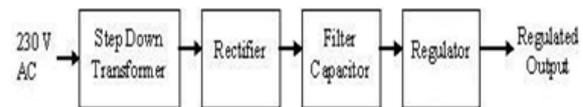

Fig 4. Block Diagram.

III. TRANSFORMER

A transformer consists of two coils also called as "WINDINGS" namely PRIMARY & SECONDARY. They are linked together through inductively coupled electrical conductors also called as CORE.

A changing current in the primary causes a change in the Magnetic Field in the core & this in turn induces an alternating voltage in the secondary coil. If load is applied to the secondary then an alternating current will flow through the load. If we consider an ideal condition then all the energy from the primary circuit will be transferred to the secondary circuit through the magnetic field.

$$P_{primay} = P_{secondary}$$

So,

$$I_p V_p = I_s V_s$$

The secondary voltage of the transformer depends on the number of turns in the Primary as well as in the secondary.

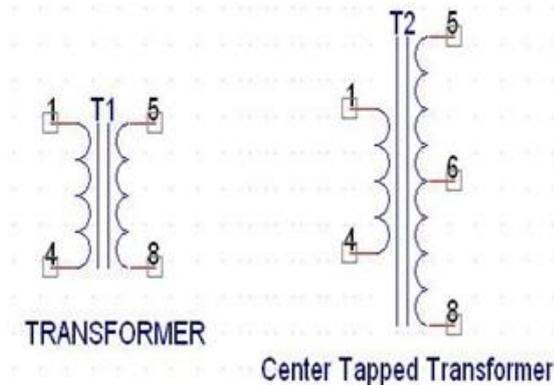$$\frac{V_s}{V_p} = \frac{N_s}{N_p}$$

Fig 5. Transformer.

IV. CIRCUIT DIAGRAM OF POWER SUPPLY

It supports an input voltage of 10 volts to 35 volts and output voltage of 5 volts. It has a current rating of 1 amp although lower current models are available. Its output voltage is fixed at 5.0V. The 7805 also has a built-in current limiter as a safety feature. 7805 is manufactured by many companies, including National Semiconductors and Fairchild Semiconductors.

The 7805 will automatically reduce output current if it gets too hot.The last two digits represent the voltage; for instance, the 7812 is a 12-voltregulator. The 78xx series of regulators is designed to work in complement with the 79xx series of negative voltage regulators in systems that provide both positive and negative regulated voltages, since the 78xx series can't regulate negative voltages in such a system.

The 7805 & 78 is one of the most common and well-known of the 78xx series regulators, as it's small component count and medium-power regulated 5V make it useful for powering TTL devices.
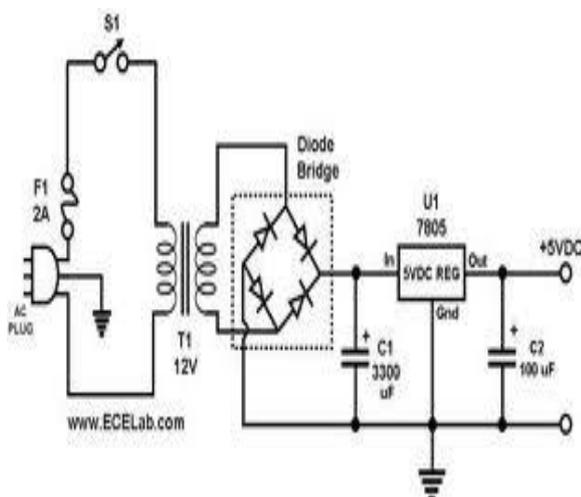
Table 1. Specifications of IC7805.

SPECIFICATIONS	IC 7805
V_{out}	5V
V_{ein} - V_{out} Difference	5V - 20V
Operation Ambient Temp	0 - 125°C
,Output I_{max}	1A

V. ARDUINO NANO (MICRO CONTROLLER)

The Arduino Nano, as the name suggests is compact, complete and bread-board friendly microcontroller board. The Nano board weighs around 7 grams with dimensions of 4.5 cms to 1.8 cms (L to B). This article discusses about the technical specs most importantly the pinout and functions of each and every pin in the Arduino Nano board.

Arduino Nano has similar functionalities as Arduino Duemilanove but with a different package. The Nano is inbuilt with the ATmega328P microcontroller, same as the Arduino UNO. The main difference between them is that the UNO board is presented in PDIP (Plastic Dual-In-line Package) form with 30 pins and Nano is available in TQFP (plastic quad flat pack) with 32 pins. The extra 2 pins of Arduino Nano serve for the ADC functionalities, while UNO has 6 ADC ports but Nano has 8 ADC ports. The Nano board doesn't have a DC power jack as other Arduino boards, but instead has a mini-USB port. This port is used for both programming and serial monitoring. The fascinating feature in Nano is that it will choose the strongest power source with its potential difference, and the power source selecting jumper is invalid.
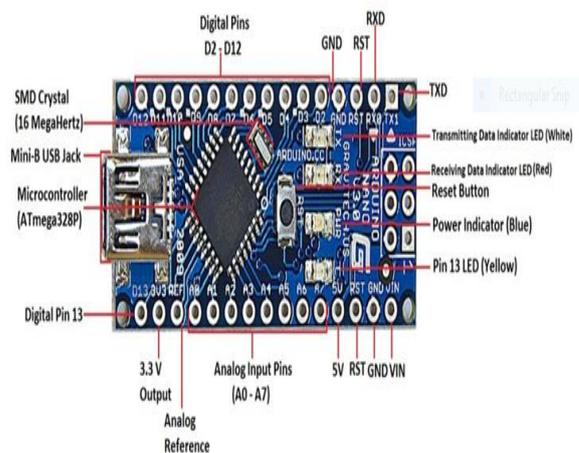

Fig 6. Circuit Diagram.

Fig 7. Arduino Nano (Microcontroller).

Table 2. Specification of Arduino Nano.

Arduino Nano	Specifications
Analog I/O Pins	8
Architecture	AVR
Clock Speed	16 MHz
DC Current per I/O Pins	40 milliAmps
Digital I/O Pins	22
EEPROM	1 KB
Flash Memory	32 KB of which 2 KB used by Bootloader
Input Voltage	(7-12) Volts
Microcontroller	ATmega328P
Operating Voltage	5 Volts
PCB Size	18 x 45 mm
Power Consumption	19 milliAmps
PWM Output	6
SRAM	2KB
Weight	7 gms

VI. D.C. MOTOR

A dc motor uses electrical energy to produce mechanical energy, very generally through the interaction of magnetic fields and current-containing conductors. The reverse process, producing electrical energy from mechanical energy, is carried out by an alternator, source or dynamo.

Many types of electric motors can be run as sources, and vice verse. The input of a DC motor is current/voltage and its output is torque (speed).

The DC motor has two basic parts: the rotating part that is called the armature and the stable part that includes coils of wire called the field coils. The stationary part is also called up the stator. Figure shows a depict of a distinctive DC motor, Figure shows a picture of a DC armature, and Figure shows a picture of a distinctive stator.

From the picture you can see the armature is made of coils of wire wrapped around the core, and the core has an covered shaft that rotates on charges. You should also notice that the ends of each coil of wire on the armature are finished at one end of the armature. The outcome points are called the commutator, and this is where's brushes make electrical contact to bring electrical current from the stationary part to the rotating part of the machine.

1. Operation:
The DC motor you will find in modem industrial applications operates very similarly to the simple DC motor described earlier in this chapter. Figure 12-9 demonstrates an electrical diagram of a simple DC motor. comment that the DC voltage is applied directly to the field winding and the brushes.

The armature and the area are both shown as a coil of wire. In afterward diagrams, a field resistor will be added in series with the field to control the motor speed. When voltage is applied to the motor, current begins to flow by the field coil from the negative terminal to the positive terminal. This sets up a inviolable magnetic field in the field winding. Current also begins to feed through the brushes into a commutator segment and then through an armature coil.

The current goes forward to flow through the coil back to the brush that is attached to other end of the coil and returns to the DC power source. The current flow in the armature coil sets up a strong magnetic field in the armature.
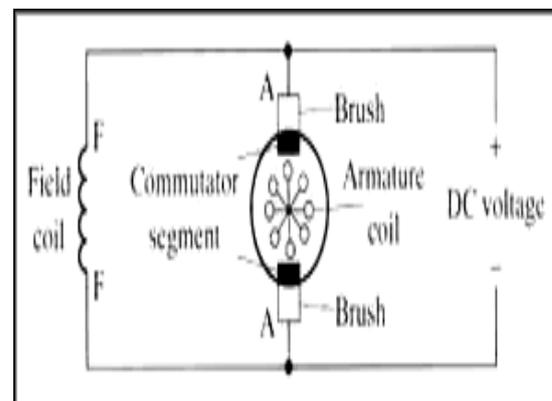

Fig 8. D.C. Motor.

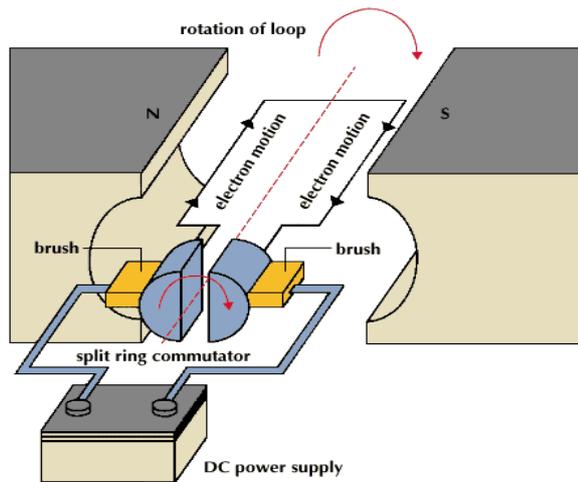Fig 9. Simple electrical diagram of DC motor.

Fig 10. Operation of a DC Motor.

The magnetic field in the armature and field coil causes the armature to begin to rotate. This occurs by the dissimilar magnetic poles attracting each other and the like magnetic poles grossing out each other.

As the armature begins to rotate, the commutator sections will also begin to move beneath the brushes. As an individual commutator segment moves under the brush connected to positive voltage, it will become positive, and when it impresses under a brush connected to negative voltage it will turn negative.

In this way, the commutator segments continually change polarity from positive to negative. Since the commutator segments are associated to the ends of the wires that make up the field winding in the armature, it induces the magnetic field in the armature to change polarity continually from north pole to south pole.

The commutator sections and brushes are aligned in such a way that the switch in polarity of the armature coincides with the location of the armature's magnetic field and the field winding's magnetic field. The switching accomplish is timed so that the armature will not lock up magnetically with the field. Rather the magnetic fields tend to build on each other and provide additional torque to keep the motor shaft rotating.

When the voltage is de-energized to the motor, the magnetic fields in that armature and the field winding will quickly diminish and the armature shaft's speed will begin to drop to zero. If voltage is enforced to the motor again, the magnetic fields will toughen and the armature will begin to rotate again.

2. Specifications:
- DC supply: 4 to 12V
- RPM: 300 at 12V
- Total length: 46mm
- Motor diameter: 36mm
- Motor length: 25mm
- Brush type: Precious metal
- Gear head diameter: 37mm
- Gear head length: 21mm
- Output shaft: Centred
- Shaft diameter: 6mm
- Shaft length: 22mm
- Gear assembly: Spur
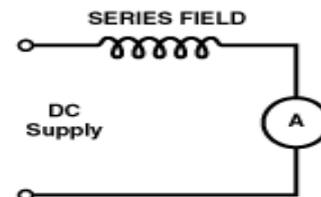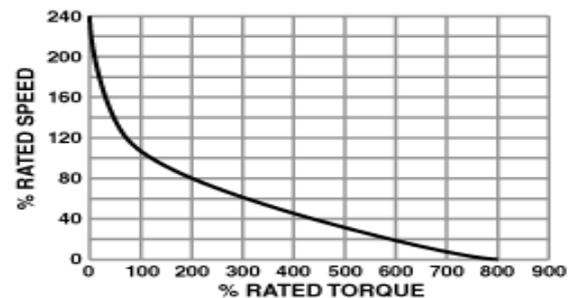- Motor weight: 105gms

3. Graphical Representation:

Fig 11. Graphical Representation.

4. Applications of Dc Motors:
- **Electric Train:** A kind of DC motor called the DC Series Motor is used in Electric Trains. The DC Series Motors have the attribute to deliver more power when they are affluent more. So the more the people get on a train, the more herculean the train becomes.
- **Elevators:** The best bidirectional motors are DC motors. They are expended in elevators. Compound DC Motors are used for this covering.
- **DC Fans, CD ROM Drives, and Hard Drives:** All these things need motors, very miniature motors, with great exactness. AC motors can never conceive of any application in these places.
- **Starter Motors in Automobiles:** An automobile battery supplies DC, so a DC motor is best fitted here. Also, you cannot start an engine with a small sized AC motor,
- Electrical Machines Lab in Colleges.

VII. APPLICATIONS OF EMBEDDED SYSTEMS

1 Consumer Applications:
At home we use a number of embedded systems which include microwave oven, remote control, vcd players, dvd players, camera etc.

Fig 12. Automatic coffee makes equipment.

2. Office Automation:
We use systems like fax machine, modem, printer etc.

Fig 13. Fax Machine.

Fig 14. Printing Machine

3. Industrial Automation:

Fig 15. Robot.

Today a lot of industries are using embedded systems for process control. In industries we design the embedded systems to perform a specific operation like monitoring temperature, pressure, humidity ,voltage, current etc.., and basing on these monitored levels we do control other devices, we can send information to a centralized monitoring station.

In critical industries where human presence is avoided there we can use robots which are programmed to do a specific operation.

VIII. CONCLUSION

By this project, our aim is to provide remote controlling of speed and direction of DC motor to the employees, operator and workers of any workplace or premises in which controlling of motor is required. Controlling of motor can be achieve by controlling the value of analog Write to motor driver given by Arduino PWM pins.

The maximum value of PWM signal is 255 which can be increase as well as decrease in terms of steps divided into equal no of intervals. The value of this interval can be as such as we required. This technique of controlling of motor is safe, efficient, easy and reliable.

For an improvement into in this project we can add some feature such detecting the speed of motor in terms of RPM. For which we just have to put a sensor to detect the speed of motor. The one can interact with the Bluetooth enabled device and can send control signal according to their required performance. Such device can be connected to the Bluetooth module of the circuit by installing a Bluetooth controller application.

In such application we just have to set the data of keys according to our compiled program. After that when we connect the device with the Bluetooth module and give command signal, it control the motor according to instructions define in the source code. Bluetooth consumes less power than other devices. Android application is user-friendly.

Technically soundpersons are not required to operate the machine. Wireless communication is enhanced. In future it can also be used in home automation, control of lighting system and in many industrial applications where adjustable speed drive are required for improving the quality of the product.

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