

IMPLEMENTATION OF DC MOTOR DRIVE CONTROL BY SPEECH RECOGNITION

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ABSTRACT

This paper introduces a new approach to control and drive the DC motor, using speech recognition. The speech signal can be provided through microphone that is connected to computer. A DC motor connected through microcontroller can be driven in forward or reverse direction at different speeds, as well as it can be stopped by giving speech command. The objective of this project is to develop a speech recognition based speed control system for DC motor using 89C51Microcontroller. User can control the speed of the motor by using him/her voice. The speed of a DC motor depends on armature voltage and flux. If the field current is maintained constant, the speed is directly proportional to armature voltage. So by varying armature voltage, it is possible to control the speed of the motor.

Keywords : Dc Motor, Brushed DC Electric Motor, Brushless DC Motor, Speech Recognition Kit

INTRODUCTION

Direct current (DC) motors have variable characteristics and are used extensively in variable-speed drives. DC motor can provide a high starting torque and it is also possible to obtain speed control over wide range. So, it is important to make a controller to control the speed of DC motor in desired speed. DC motor plays a significant role in modern industrial. These are several types of applications where the load on the DC motor varies over a speed range. These applications may demand high-speed control accuracy and good dynamic responses.[1-5] The speed of the DC Motor will be controlled by the Voice Inputs Commands. This is a voltage based speed control system, which uses the special voice IC, Microcontroller to process the commands and control the speed. In this Project - to start the motor, we use a command, for example 1 to start the

motor. Similarly other commands like 2 to increase the speed of the DC motor from the current level, 3 to increase the speed of the DC motor more from the 2nd level, 4 for the maximum speed of the motor. Similarly 5 to stop the motor the speed of the motor will be sensed by the proximity based Speed sensor and the respective speed will be Either Seven-segment display or LCD display.[6-11]

2. BLOCK DIAGRAM

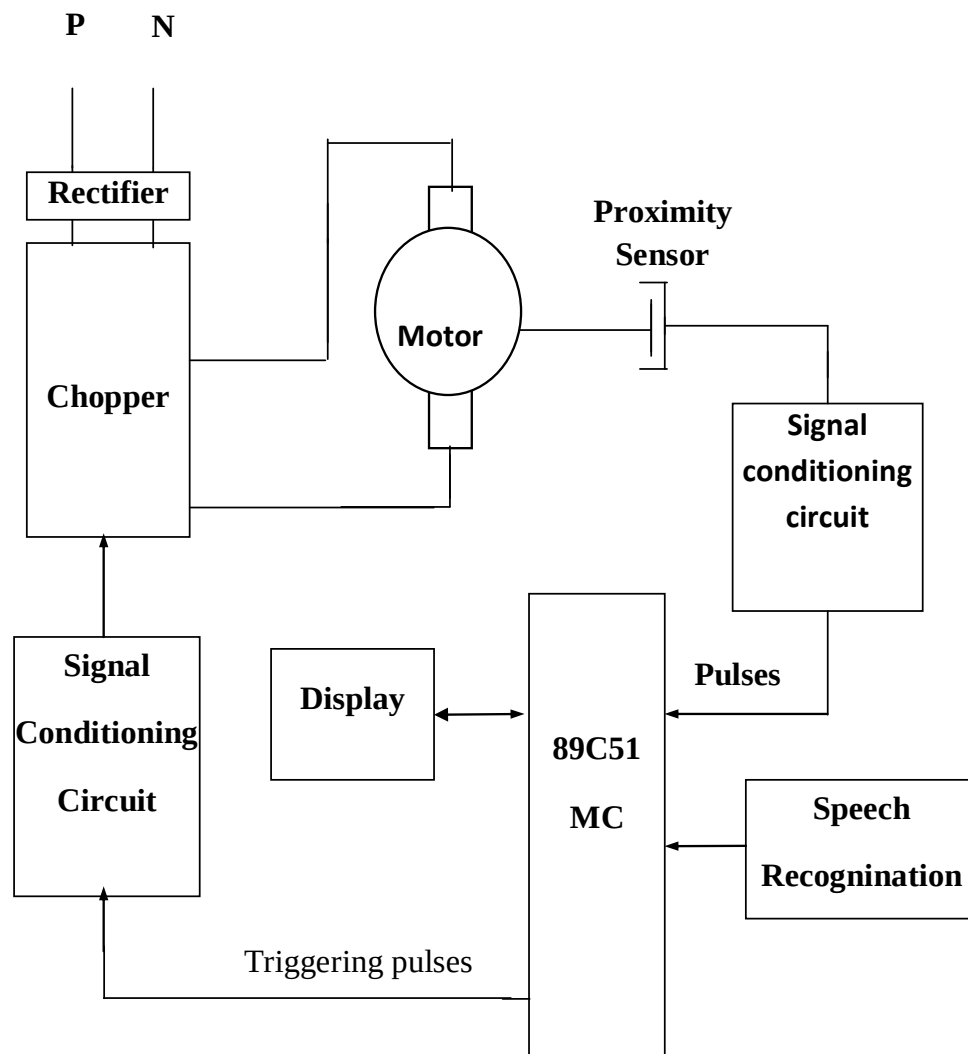


Figure 1 Block Diagram of speech recognition based speed control system for DC motor using 89C51Microcontroller

2.1 PRINCIPLE OF OPERATION

According to block diagram the dc motor is controlled by microcontroller by voice commands .first power supply is given to the chopper by rectifier (it converts the ac supply to dc).Mainly chopper is used to control the dc motor. First we give the voice command to the speech recognition then the input is recognized and converts the signal from analog to digital. The digital signal is then the input [12-14] of the microcontroller 89c51.Microcontroller gives triggering pulses to the chopper by means of the signal conditioning circuit and the chopper controllers the dc motor. Proximity sensor is feedback circuit is used to detect the speed of the dc motor and convey the signal to the microcontroller by signal conditioning circuit. For example we give voice command “START “then “STOP” then “FORWARD” “REVERSE“ “UP” and “DOWN” to the speech recognition kit. First the “START “command is recognized and give signal to the micro controller .Microcontroller gives the pulse for start to the chopper by signal conditioning circuit and the motor starts itself and displays in display unit. Then the second command “STOP” is recognized and give signal to the micro controller .Microcontroller gives the pulse for stop to the chopper by signal conditioning circuit and the motor stops itself and displays in display unit.[15-19] Then the third command “FORWARD” is recognized and give signal to the micro controller .Microcontroller gives the pulse for forward to the chopper by signal conditioning circuit and the motor starts itself and displays in display unit. Then the fourth command “REVERSE” is recognized and give signal to the micro controller .Microcontroller gives the pulse for start to the chopper by signal conditioning circuit and the motor starts itself and displays in display unit. Then the fifth command “UP” is recognized and give signal to the micro controller .Microcontroller gives the pulse for up to the chopper by signal conditioning circuit and the motor speeds up itself and displays in display unit. Then the fourth command “DOWN” is recognized and give signal to the micro controller .Microcontroller gives the pulse for down to the chopper by signal conditioning circuit and the motor speed down itself and displays in display unit.

2.2 BRUSHED DC ELECTRIC MOTOR

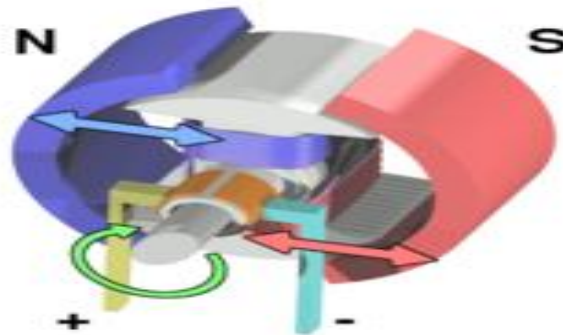


Figure 2 Brushed DC Electric Motor

Workings of a brushed electric motor with a two-pole rotor and permanent-magnet stator. ("N" and "S" designate polarities on the inside face of the magnets; the outside faces have opposite polarities.)[20-22]

DC motors have AC in a wound rotor also called an armature, with a split ring commutator, and either a wound or permanent magnet stator. The commutator and brushes is a long-life rotary switch. The rotor consists of one or more coils of wire wound around a laminated "soft" ferromagnetic core on a shaft; an electrical power source feeds the rotor windings through the commutator and its brushes, temporarily magnetizing the rotor core in a specific direction. The commutator switches power to the coils as the rotor turns, keeping the magnetic poles of the rotor from ever fully aligning with the magnetic poles of the stator field, so that the rotor never stops (like a compass needle does), but rather keeps rotating as long as power is applied.[23-24]

Many of the limitations of the classic commutator DC motor are due to the need for brushes to press against the commutator. This creates friction. Sparks are created by the brushes making and breaking circuits through the rotor coils as the brushes cross the insulating gaps between commutator sections. Depending on the commutator design, this may include the brushes shorting together adjacent sections – and hence coil ends – momentarily while crossing the gaps. Furthermore, the inductance of the rotor coils causes the voltage across each to rise when its circuit is opened, increasing the sparking of the brushes.[25-29] This sparking limits the maximum speed of the machine, as too-rapid sparking will overheat, erode, or even melt the commutator. The current density per unit area of the brushes, in combination with their

resistivity, limits the output of the motor. The making and breaking of electric contact also generates electrical noise; sparking generates RFI.[30-34] Brushes eventually wear out and require replacement, and the commutator itself is subject to wear and maintenance (on larger motors) or replacement (on small motors). The commutator assembly on a large motor is a costly element, requiring precision assembly of many parts. On small motors, the commutator is usually permanently integrated into the rotor, so replacing it usually requires replacing the whole rotor.

While most commutators are cylindrical, some are flat discs consisting of several segments (typically, at least three) mounted on an insulator.[35-39]

Large brushes are desired for a larger brush contact area to maximize motor output, but small brushes are desired for low mass to maximize the speed at which the motor can run without the brushes excessively bouncing and sparking (comparable to the problem of "valve float" in internal combustion engines). (Small brushes are also desirable for lower cost.) Stiffer brush springs can also be used to make brushes of a given mass work at a higher speed, but at the cost of greater friction losses (lower efficiency) and accelerated brush and commutator wear. Therefore, DC motor brush design entails a trade-off between output power, speed, and efficiency/wear.

2.3 BRUSHLESS DC MOTOR

Some of the problems of the brushed DC motor are eliminated in the brushless design. In this motor, the mechanical "rotating switch" or commutator/brush gear assembly is replaced by an external electronic switch synchronized to the rotor's position. Brushless motors are typically 85–90% efficient or more, efficiency for a brushless electric motor, of up to 96.5% was reported whereas DC motors with brush gear are typically 75–80% efficient.

Midway between ordinary DC motors and stepper motors lies the realm of the brushless DC motor. Built in a fashion very similar to stepper motors, these often use a permanent magnet external rotor, three phases of driving coils, may use Hall Effect sensors to sense the position of the rotor, and associated drive electronics. [40-42]The coils are activated, one phase after the other, by the drive electronics as cued by the signals from either Hall effect sensors or from the back EMF (electromotive force) of the undriven coils. In effect, they act as three-phase

synchronous motors containing their own variable-frequency drive electronics. A specialized class of brushless DC motor controllers utilizes EMF feedback through the main phase connections instead of Hall Effect sensors to determine position and velocity. These motors are used extensively in electric radio-controlled vehicles. When configured with the magnets on the outside, these are referred to by modelers as out runner motors.

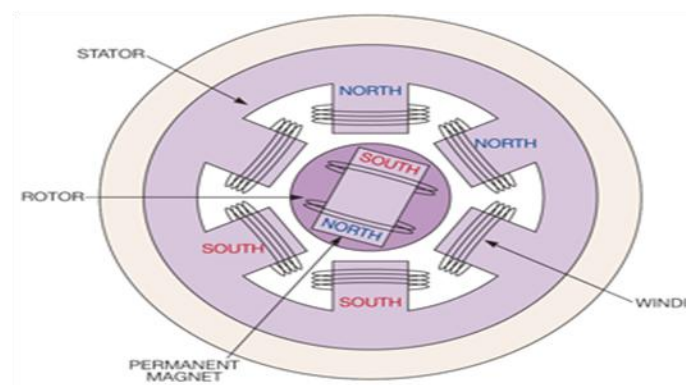


Figure 3 Brushless DC Motor

Brushless DC motors are commonly used where precise speed control is necessary, as in computer disk drives or in video cassette recorders, the spindles within CD, CD-ROM (etc.) drives, and mechanisms within office products such as fans, laser printers and photocopiers. They have several advantages over conventional motors:[43-45]

- Compared to AC fans using shaded-pole motors, they are very efficient, running much cooler than the equivalent AC motors. This cool operation leads to much-improved life of the fan's bearings.
- Without a commutator to wear out, the life of a DC brushless motor can be significantly longer compared to a DC motor using brushes and a commutator. Commutation also tends to cause a great deal of electrical and RF noise; without a commutator or brushes, a brushless motor may be used in electrically sensitive devices like audio equipment or computers.

- The same Hall Effect sensors that provide the commutation can also provide a convenient tachometer signal for closed-loop control (servo-controlled) applications. In fans, the tachometer signal can be used to derive a "fan OK" signal as well as provide running speed feedback.
- The motor can be easily synchronized to an internal or external clock, leading to precise speed control.
- Brushless motors have no chance of sparking, unlike brushed motors, making them better suited to environments with volatile chemicals and fuels. Also, sparking generates ozone which can accumulate in poorly ventilated buildings risking harm to occupants' health.
- Brushless motors are usually used in small equipment such as computers and are generally used in fans to get rid of unwanted heat.[12-19]
- They are also acoustically very quiet motors which is an advantage if being used in equipment that is affected by vibrations.

Modern DC brushless motors range in power from a fraction of a watt to many kilowatts. Larger brushless motors up to about 100 kW rating are used in electric vehicles. They also find significant use in high-performance electric model aircraft

2.4 SPEECH RECOGNITION KIT

Multi-purpose speech recognition module EasyVR is a multi-purpose speech recognition module designed to add versatile, robust and cost effective speech and voice recognition capabilities to virtually any application. EasyVR is the second generation version of the successful VRbot module and builds on the features and functionality of its predecessor.

The EasyVR module **can be used with any host with an UART interface powered at 3.3V - 5V**, such as PIC and Arduino boards. It is ideal for applications such as home automation (voice controller light switches, locks, beds) or adding hearing to most popular robots on the market.[20-22]

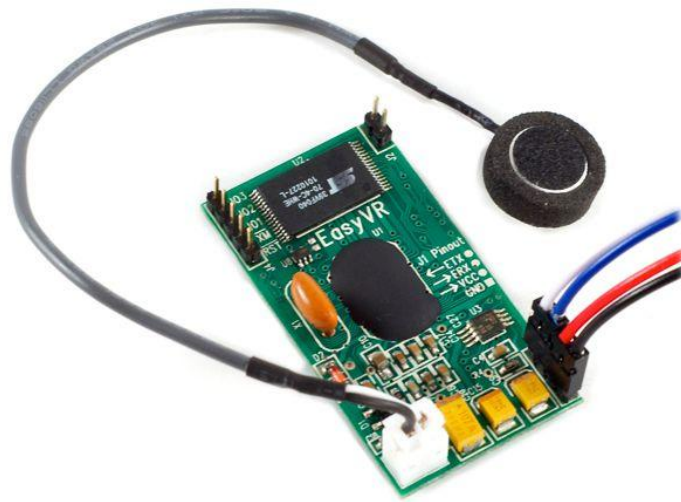


Figure 4 Speech Recognition Kit

2.5 VOICE RECOGNITION KIT

The speech recognition system is a completely assembled and easy to use programmable speech recognition circuit. Programmable, in the sense that you train the words (or vocal utterances) you want the circuit to recognize. This board allows you to experiment with many facets of speech recognition technology.[17-21] It has 8 bit data out which can be interfaced with any microcontroller for further development. Some of interfacing applications which can be made are controlling home appliances, robotics movements, Speech Assisted technologies, Speech to text translation, and many more. Self-contained stand alone speech recognition circuit- User programmable .Up to 20 word vocabulary of duration two second each Multi-lingual

3. HARDWARE IMPLEMENTATION

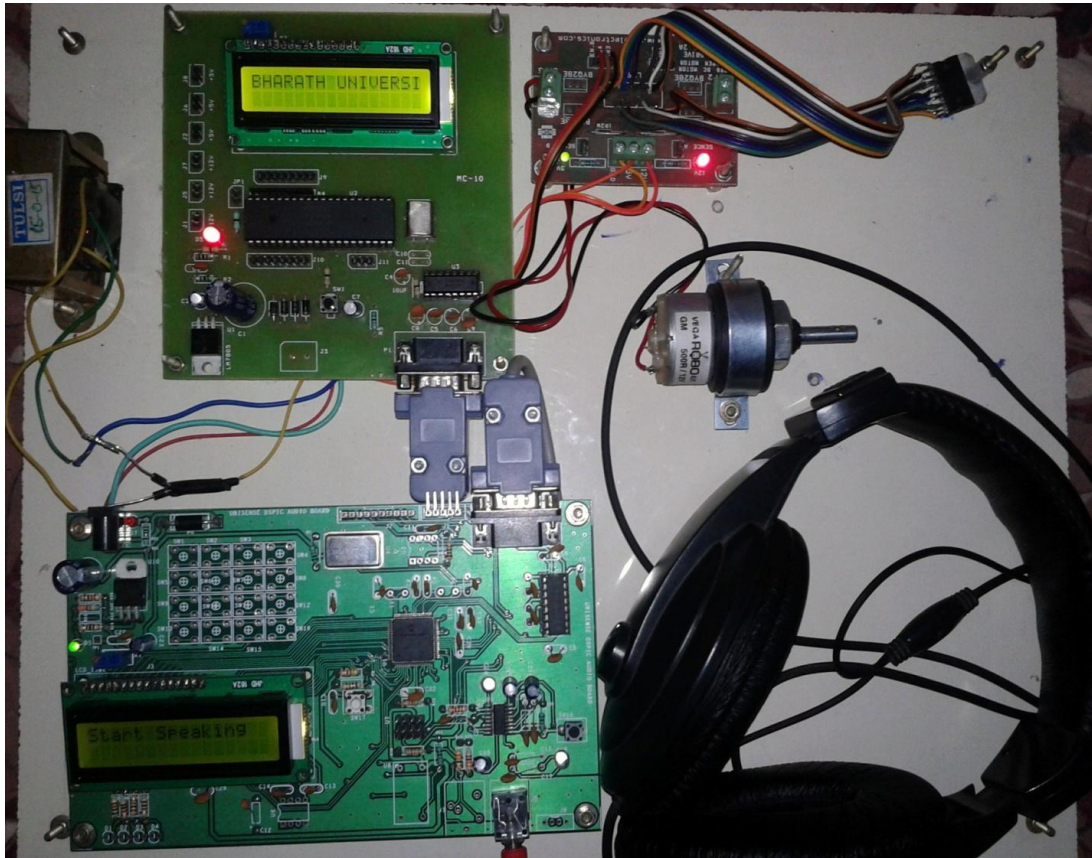


Figure 5 Image of the project

CONCLUSION

This project introduces a new approach to control and drive the DC motor, using speech recognition.[22-29] A DC motor connected through microcontroller can be driven in forward or reverse direction at different speeds, as well as it can be stopped by giving speech command. Every electric motor has to have some sort of controller. The motor controller will have differing features and complexity depending on the task that the motor will be performing.

By this project the motor needn't to be manually operated it will operate by the voice the user. This may allow reduced-voltage starting of the motor, reversing control or selection of

multiple speeds. In future this project is more helpful to the Industrial area because no need so much switches to control the motor only the user voice can control the motor. It will be reduce the cost of switches and no need more workers to control the motor. Controlling the dynamics of the machine and its response to applied loads. (Speed, torque and efficiency of the machine or the position of its moving elements.) Protecting the motor and the controller itself from damage or abuse. [40-45]

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