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SMART CONTROL OF DC MOTOR BY VOICE RECOGNITION USING IOT

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***ABSTRACT*:** In this project work, the control of dc motor has been done through speech or voice recognition. Due to the advancement of wireless technologies, several techniques are introduced such as GSM, Wi-Fi, ZIGBEE and Bluetooth. Each of these techniques has their own unique specifications and applications. Among these wireless technologies, Bluetooth technique has been chosen for this project. In this work, Arduino board, Bluetooth, sensors [speed, temperature and gas], Android mobile have been used. Speeds, direction of rotation of the DC motor are the key parameters going to be controlled through voice recognition by PWM technique. Through various types of sensors, speed and temperature of the DC motor, gas detection around the motor are monitored. Using voice as input for control of motor will reduce the manual operation. It also reduces the losses that occur due to resistance in conventional methods of speed control of DC motor.Proposed methodology will ease the complexity of humans working in hazardous environment. In this system, two way communication is possible i.e. sending input as a voice command to the system and receiving the sensed data to android mobile via Bluetooth module using arduino.

***KEY WORDS*:** Arduino UNO, Bluetooth module (HC-05), IR Speed sensor, Android phone, DC Motor, Gas sensor, Temperature sensor

I.INTRODUCTION

There is a huge loss of life working in hazardous environment each year. After the boom of technology this loss is reduced to considerable amount. To create an alternative to work in hazardous environment voice control was developed [1, 2]. Through mobile one could communicate with the hardware in parts of the world by sending voice control through mobile. In this work, voice command is used as input to control the DC motor.DC motors have variable characteristics and are extensively used in variable speed drives. DC motors can provide high starting torque and it is also possible to obtain speed control over a wide range. The speed and direction of rotation of DC motor will be controlled by voice input commands. PMW technique can be used to control the speed of DC motor [3-6]. Arduino is used to process the commands and IR sensor is used to sense the speed. Temperature and gas sensors are used to monitor the temperature and gas parameters. Corresponding parameters will be displayed on LCD display and sensed parameters can be retrieved to the android mobile by using specific applications in Android mobile.In the system designed, android phone is used for voice recognition with installed applications. The voice input given to phone is converted to text and sent to the Arduino board using Bluetooth. For this purpose Bluetooth module is interfaced with the Arduino. The text received at Arduino is decoded. The program is executed and the control signal is given to the motor driver circuit. The driver circuit controls the speed and direction of the DC motor.

II.EXISTING METHODS

In the existing model, motor is controlled by power electronic devices. These devices are having their own losses while switching and regulating**.** The three common methods used for speed control of DC motor are Flux Control Method, Armature Control Method, and Voltage Control Method. The disadvantages associated with these methods of speed control are the switching losses and high cost involved. The operating person may also be subjected to shocks if not handled properly. To overcome these associated drawbacks, voice based control has been developed. Voice based control of DC motor has been done initially using 89C51/52 microcontrollers. Microcontroller will produce PWM output to control the rotation of the DC motor [7,8]. Later, the same technique has been done using node MCU [9].Due to advantages of arduino over other microcontrollers, it is being preferred. It processes the given voice commands accordingly to control the DC motor [10].

III. PROPOSED METHODOLOGY

The voice of the person is given as input to an android mobile having an application which recognises the command given by the person and the application name is Ghost remote. In this work, arduino has been chosen as it is cheap and flexible to use. The voice is converted into text and then passed to arduino via Bluetooth module (HC-05). The text is then converted into pulsating signal with suitable duty cycle by pulse width modulation. The pulse width modulated signal is converted to driving signal. This is done by motor driver. Then by giving suitable commands regarding speed and direction, the motor rotates in specified speed and direction. The speed is sensed by IR speed sensor. The speed sensed can be received via Bluetooth to the Android mobile. The speed sensed and the commands that reach the Arduino are displayed using a LCD display. Temperature sensor senses the surrounding temperature value and gas sensor will sense the gas around the motor which are also displayed on LCD. The sensed data such as speed, temperature, and gases concentration around the motor can be retrieved to the android mobile through specific applications.

IV.DESCRIPTION OF PROPOSED SYSTEM

In this proposed system as shown in Fig 1, android mobile, Bluetooth module, arduino UNO, driver circuit, sensors [speed, gas and temperature] , LCD display have been utilized.

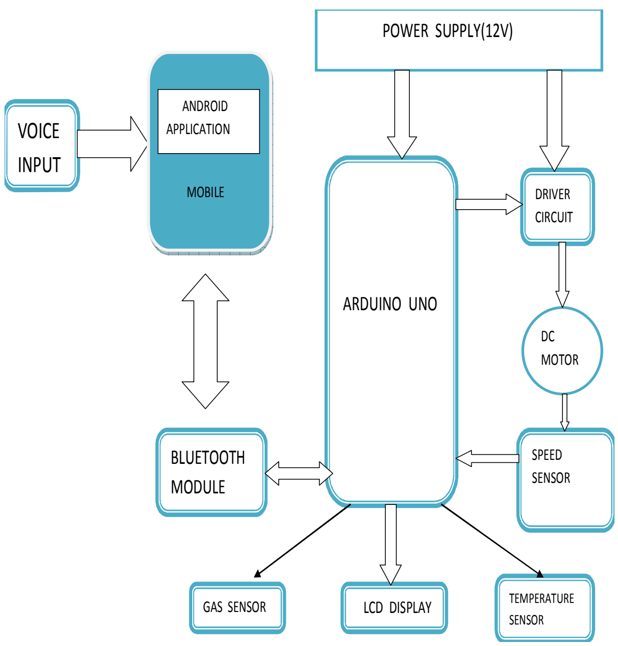


Fig 1 Block diagram of the proposed system

Voice input is given to the android mobile phone. The mobile uses an android application named ghost remote for voice recognition. The application has the feature of sending voice commands from the mobile phone to the arduino to which the phone is connected. Voice command is given to mobile phone. The specific app that already installed in the mobile converts the voice into text, which is then send to the Arduino board via Bluetooth module. The voice is sent to the Bluetooth module interfaced with Arduino UNO. HC-05 is the Bluetooth module used to interface android mobile with Arduino Uno. Voice command is converted into radio signal with frequency 2.4 GHz and transmitted to the Arduino UNO. It converts the given text input signal to pulsating signal by pulse width modulation (PWM) using Arduino programming. The Arduino is programmed using ARDUINO IDE software. The PWM signal is converted into the driving signal. This is done by motor driver L298. The motor driver can run two motors simultaneously given output from 5V-35V.

When the phone is connected to the Arduino board, the Bluetooth module stops blinking fast, this indicates that the system is ready. Then give the voice input “start”. Now give the direction in which the motor is to be rotated depending upon the application.Clockwise and anticlockwise directions of rotation of motor are possible. The two commands used to control the direction are “forward” (forward means clockwise direction of rotation of motor shaft) and “backward” (backward means anticlockwise direction of rotation of motor shaft) . After that give voice input to phone by giving the speed at which the motor is rotated. Three modes of speeds i.e. Low speed, medium speed, high speed is possible in both clockwise and anticlockwise directions. Then the motor starts rotating in the specified direction and speed. The speed is sensed by the IR speed sensor. The speed sensor is directly connected to the Arduino UNO board. It has got an IR transmitter and receiver. The speed of the motor is measured continuously for enabling a closed loop operation, so that the reliability of the system increases. The speed sensed and the commands that reach the Arduino are displayed using a LCD display. And also the output will be send to the android mobile via Bluetooth module by using an application named as Bluetooth terminal. The gas concentration around the motor and temperature surrounding the DC motor are displayed on the LCD. In addition to that, these parameters are also retrieved to mobile.

Hardware Components

A. *ARDUINO UNO*

Arduino Uno is a microcontroller board based on the atmega328p (datasheet).Ithas14digital input/outputpins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 mhz quartz crystal, a USB connection, a power jack, an ICSP header and a reset button as shown in Fig.2. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with an AC-to-DC adapter or battery to get started. You can tinker with your UNO without worrying too much about doing something wrong, worst case scenario you can replace the chip for a few dollars and start over again."Uno" means one in Italian and was chosen to mark the release of Arduino Software (IDE) 1.0. The Uno board and version 1.0 of Arduino Software (IDE) were the reference versions of Arduino, now evolved to newer releases. The Uno board is the first in a series of USB Arduino boards, and the reference model for the Arduino platform; for an extensive list of current, past or outdated boards see the Arduino index.

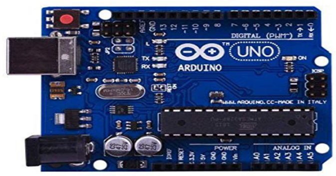


Fig. 2 Arduino Uno

B. *BLUETOOTH MODULE (HC-05)*

HC-05 module is an easy to use Bluetooth SPP (Serial Port Protocol) module, designed for transparent wireless serial connection setup. The HC-05 Bluetooth Module can be used in a Master or Slave conFiguration, making it a great solution for wireless communication. The serial port Bluetooth module as in Fig.3 is fully qualified Bluetooth V2.0+EDR (Enhanced Data Rate) 3Mbps Modulation with complete 2.4GHz radio transceiver and baseband. It uses CSR Blue core 04 External single chip Bluetooth system with CMOS technology and with AFH (Adaptive Frequency Hopping Feature).The Bluetooth module HC-05 is a MASTER/SLAVE module. By default the factory setting is SLAVE. The Role of the module (Master or Slave) can be conFigured only by AT COMMANDS. The slave modules cannot initiate a connection to another Bluetooth device, but can accept connections. Master module can initiate a connection to other devices. The user can use it simply for a serial port replacement to establish connection between MCU and GPS, PC to your embedded project, etc. Just go through the datasheet for more details. The specifications of the module are Operating voltage-(4-6V), Current rating-30mA and Range-Up to 10m

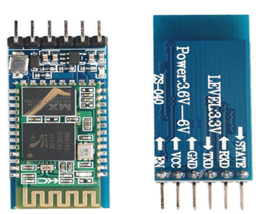


Fig.3 Bluetooth module

C. *LCD DISPLAY*

LCD (Liquid Crystal Display) screen shown in Fig.3 is an electronic display module and used in wide range of applications. A 16×2 LCD display is very basic module and is very commonly used in various devices and circuits with voltage and current ratings of (3-9V),1mA. These modules are preferred over seven segments and other multi segment LEDs. The reason is that LCDs are economical, easily programmable, have no limitation of displaying special and even custom characters, animations and so on. A 16×2 LCD means it can display 16 characters per line and there are 2 such lines. In this LCD each character is displayed in 5×7 pixel matrix. This LCD has two registers namely, Command and Data. The command register stores the command instructions given to the LCD. The data register stores the data to be displayed on the LCD. The data is the ASCII value of the character to be displayed on the screen.

Fig.4 Liquid Crystal Display

D. *MOTOR DRIVER (L298)*

The L298N shown in Fig .5 is an integrated monolithic circuit in a 15- lead Multi-watt and PowerSO20 packages. It is a high voltage, high current dual full-bridge driver de-signed to accept standard TTL logic level sand drive inductive loads such as relays, solenoids, DC and stepping motors. The driver has high operating voltage, which can be up to 35 volts. It can provide a current of 4Ai.e,2A per channel. L298 have a high-capacity filter capacitor and a freewheeling diode that protects devices in the circuit from being damaged by the reverse current of an inductive load, enhancing reliability of the driver. The module can be applied to Drive DC motors. Since the module uses a dual H-bridge drive, it can drive two motors at the same time.

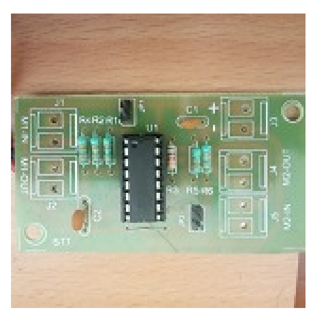


Fig. 5 Motor Driver

E. *IR SPEED SENSOR*

The IR speed sensor as in Fig. 6 is used to sense the speed of motor. Here we uses speed sensor based on the LM393 chip. It operates at a voltage of (3.3-5V) and current of about 15mA. The speed sensor uses a disc with holes (encoder disc) to block the infrared beam, thus by counting the number of times the sensors goes from low to high we can calculate the number of revolutions for a given time period. There is two infrared LED"s present in the speed sensor. One LED is IR transmitter and the other one is IR receiver (phototransistor). If no object block, the phototransistor would conduct; when something blocked the light falling on the transistor it wouldn"t conduct. When there is no object between the interrupter will be logical "0". During the rotation, the object will block light output from optocoupler will be a logical "1". IR speed sensors are cheaper and accurate.

Fig.6 IR speed sensor

F. *GAS SENSOR (MQ2)*

The Grove - Gas Sensor(MQ2) module as in Fig. 7 is useful for gas leakage detection (in home and industry). It is suitable for detecting (H2, LPG, CH4, CO, Alcohol). Due to its high sensitivity and fast response time, measurements can be taken as soon as possible. The sensitivity of the sensor can be adjusted by using the potentiometer.The operating voltage is up to 5V and the current rating is 150mA.

Fig. 7 Gas Sensor

G. *THERMISTOR*

A thermistor is a resistance thermometer whose resistance is dependent on temperature. The term is a combination of "thermal" and "resistor". It is made of metallic oxides, pressed into a bead, disk, or cylindrical shape and then encapsulated with an impermeable material such as epoxy or glass as shown in Fig.8. There are two types of thermistors: Negative Temperature Coefficient (NTC) and Positive Temperature Coefficient (PTC). With an NTC thermistor, when the temperature increases, resistance decreases. Conversely, when temperature decreases, resistance increases. This type of thermistor is used the most. A PTC thermistor works a little differently. When temperature increases, the resistance increases, and when temperature decreases, resistance decreases. This type of thermistor is generally used as a fuse. Typically, a thermistor achieves high precision within a limited temperature range of about 50ºC around the target temperature. This range is dependent on the base resistance.

Fig.8 Thermistor

H. DC MOTOR

DC motor is an electrical rotator machine which converts electrical energy into mechanical energy. Nearly all types of DC motors have some internal mechanism, either electromechanical or electronic; to periodically change the direction of current in part of the motor. The first type of electrical distribution system is DC system. So they developed dc motors. A DC motor's speed can be controlled over a wide range, using either a variable supply voltage or by changing the strength of current in its field windings. The ratings of DC motor chosen for this work are 12V, 1.25A, and 1000 rpm as shown in Fig.8.

Fig. 8 DC motor

I.POWER SUPPLY

For supplying the power to arduino and other interfaced components, a 230/12V step down transformer has been used. It provides an A.C voltage of 12V which is converted to 12V DC by using a full wave rectifier with capacitor filter.IC7805 has been used which converts this 12V DC to 5V DC. The sensors interfaced to arduino can be given supply from the output of IC7805.In order to reduce pulsations in 5V DC output, another capacitor has been used. An led with current limiting resistor has been used for indication of supply.Fig.9 indicates the full wave rectifier circuit

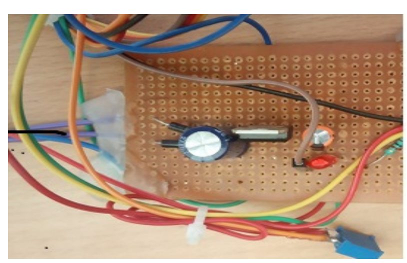


Fig. 9 Power supply

Software Used

1. ARDUINO IDE

The open-source Arduino Software (IDE) makes it easy to write code and upload it to the board. It runs on Windows, Mac OS X, and Linux. The environment is written in Java and based on Processing and other open-source software. This software can be used with any Arduino board. The Arduino IDE can be used on Windows, Linux (both 32and64 bits), and Mac OS X.

2. ANDROID APPLICATIONS

i. GHOST REMOTE

This is an application which interfaces android mobile and Bluetooth module to send the commands in the form of text to arduino. Ghost Remote (Fig 10) is primarily a Bluetooth remote for Event ghost in windows but can also be used with anything that accepts SPP as input. It can be used as an Arduino Voice Commander. Key features of this app are:

- Voice search.
-Uses Google's voice to text engine to send limitless commands to and control your computer by voice.
-Speak to your phone and watch what you've said get typed on to your big screen, this is excellent for search boxes such as in XBMC.

ii. BLUETOOTH TERMINAL

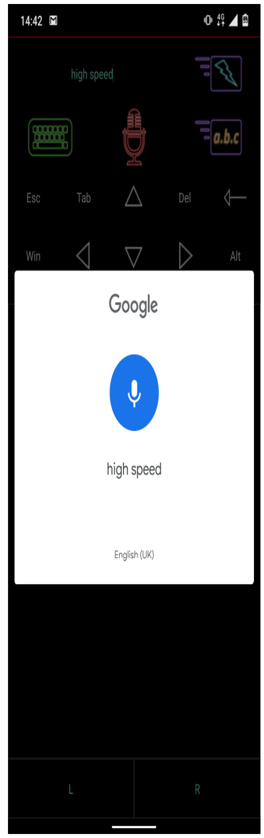
The easiest way to visualize Arduino Sensor-Data directly on your Android-Device in REALTIME! The App is able to display the values of up to 6 Sensors simultaneously. Only required is to load some Code to your Arduino-Board, wire a Bluetooth-Module (like the HC-05) to the Arduino and couple Android-Device and Bluetooth-Module in the System-Preferences. The App will establish a wireless Bluetooth-Serial-Connection between Arduino and Smartphone.This is an application which interfaces android mobile And Bluetooth module used to receive the output from Sensors to android mobile via arduino.

V. RESULT AND OUTCOMES

By sending the input as a voice command using android mobile having a specific application ghost remote, then the input command is turned into text input and sent to arduino via Bluetooth module (Fig 10). Then arduino converts the text signal into PWM signal. This pulsating signal is converted into driving signal using driver circuit. The speed and direction of rotation of motor are displayed on LCD display. Gas sensor and temperature sensor is connected to the arduino which will sense the gas concentration and temperature around the motor and these parameters are also displayed on the LCD in the hard ware kit as shown in Fig 12. By using a specific application named Bluetooth terminal in the android mobile as shown in Fig.11, the entire data that is sensed by the sensors is retrieved to the android mobile.

Values obtained are

a. High speed – 760 RPM
b. Medium speed – 470 RPM
c. Low speed – 82 RPM
d. Gas value – 9 PPM
e. Temperature – 37 degrees C
f. Direction - Forward and Backward



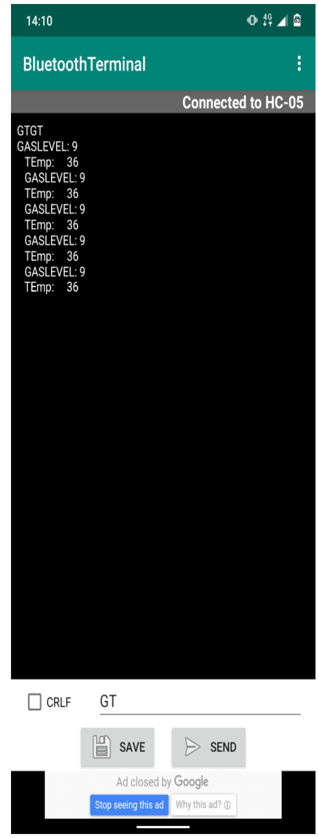


Fig 10 Ghost remote Fig.11 Bluetooth terminal

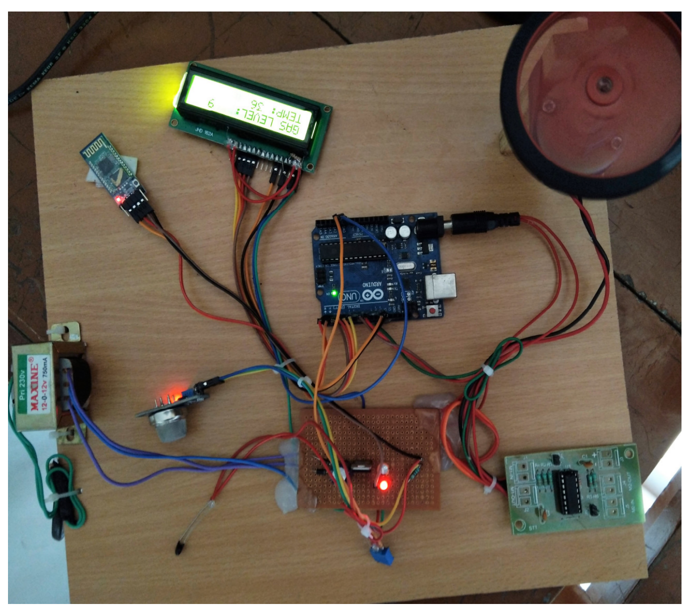


Fig 12Designed Hardware kit

VI. CONCLUSION

The proposed methodology uses wireless system with Bluetooth connectivity and Arduino UNO. With these components, fast operation has been obtained. With input as voice command, the direction of rotation and speed of the DC motor was altered. stop command has been defined to stop the DC motor. Environment around the motor is monitored by using temperature and gas sensors. This methodology will be advantageous in industries by reducing the manual operation and the complexity of persons who works in hazardous environment

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