

Human Voice Controlled Robot Embedded with Real Time Obstacle Detection and Avoidance

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Abstract—The primary focus of this research is technology speech recognition through the conversion of speech to text. Controlling of machineries using speech was not possible earlier. This analysis will help us in implementing this technology for the handicapped ones who cannot drive the vehicle on their own. The use of sensors will provide greater safety from sudden hits due to the auto braking system and slow down feature.

A Bluetooth module (HC-05) is used to establish a communication link between the car and human voice commands via Android Application. The RF transmitter of the Bluetooth can take human voice commands which are converted to encoded digital data for the advantage of an adequate range (up to 100 meters) from the robot. The receiver decodes the data before feeding it to microcontroller to drive DC motors via motor driver L298D for necessary work. An Arduino UNO is programmed to read voice commands and respond accordingly.

Ultrasonic sensors interfaced with the Arduino can help in obstacle detection. Considering this feature for the future scope might prove a milestone in vehicle automation. Further the project can be developed using IoT technology where a user can control the robot from any corner of the world.

Keywords— Ultrasonic Sensors, Bluetooth module, Motor Driver, Arduino UNO

I. INTRODUCTION

As we all know in today's world one of the most powerful and rapidly developing devices is a smartphone and all the credit goes to powerful processor chips and their mode of communication. The Internet of Things is dominating the world seamlessly. And with increasing developments in this field robots can now be controlled with lesser direct human intervention to achieve a more natural interaction with machines. Smartphones are powerful devices capable of

performing many functions similar to a computer.

In the proposed model, the movements of the vehicle are controlled using voice commands from the user. These commands are read using an Android Application on the

user's phone which is connected to the robot using a Bluetooth Module. The commands are encoded then relayed over an RF (Radio Frequency) channel and before reception they are decoded by the Bluetooth Module. The goal of Human Voice Controlled Robot (HVCR) is to respond to the commands received from the user, which are already registered within the microcontroller. The Ultrasonic sensors are most suitable for obstacle detection which are usually attached in front of the Robot.

II. BRIEFING TOPICS

A. Speech Recognition

Speech recognition is the ability of the machine to receive and interpret the human voice or to understand and carry out spoken commands. It works on the basis of algorithms that matches the sound of the dictated speech with word sequences and interpret it as a command. The algorithms used are Acoustic modeling and language modeling which helps to distinguish between similar words. Hidden Markov models are used to recognize temporal patterns in speech to improve accuracy within the speech.

However different factors can affect the performance of speech recognition like various accents, the difference in pitch and volume, way of pronunciation, and also background noise.

B. Speech vs Voice Recognition

Both of them use recordings of human voice, but they do different things with it. Voice recognition strikes out personal differences to reveal the words.

Speech recognition detects the person behind the speech. Technically, it draws out the words that are spoken whereas voice recognition purposes. For this research, just to make it user-friendly, Voice Recognition is the best identifies the voice that is speaking. Speech recognition focuses on what was said and voice recognition focuses on the person who spoke it. The underlying technologies do overlap but they serve very different methodology to control this robot

III. WORKING OF THE ROBOT

A. Algorithm

- Start.
- Establish the connection of Bluetooth module and the Android Application.
- Once connected, give predefined commands through the mobile handset to the robot.
 - Characters that are read from a single word on the Android application.
 - This will be sent wirelessly to Bluetooth module HC-05.
 - HC-05 will automatically transmit it serially to the Arduino UNO.
 - Arduino UNO will perform action on the DC motors according to the command read.
 - While moving Ultrasonic sensors will detect the obstacles.
 - Once detected the Motors will slow down and stop.
 - By the time we can provide the next command.
 - Stop.

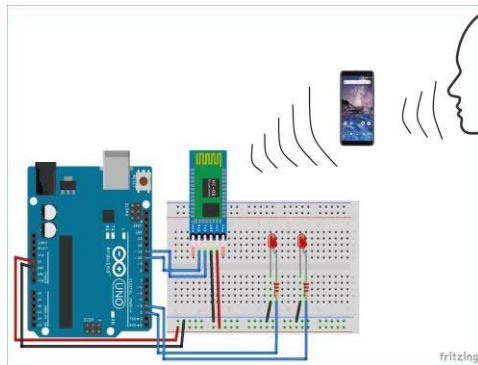


Fig.1: Work flow. [1]

B. Preprogrammed Commands for Robot:

- Forward: Activates both motors at slow speed and moves it forward.
- Backward: Activates both motors at slow speed and moves it backward.
- Fast Forward: Activates both motors at full speed and moves it fast forward.
- Fast Backward: Activates both motors at full speed and moves it backward.
- Slow Right: Activates left motor and makes a left turn.
- Slow Left: Activates right motor and makes a

right turn.

- Stop: Deactivates both motors.

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MyCar | Arduino 1.8.10
File Edit Sketch Tools Help

MyCar

if (readvoice == "*forward#")
{
  digitalWrite(3, HIGH);
  digitalWrite(4, HIGH);
  digitalWrite(5, LOW);
  digitalWrite(6, LOW);
  delay(800);
  digitalWrite(3, LOW);
  digitalWrite(4, LOW);
  digitalWrite(5, LOW);
  digitalWrite(6, LOW);
  delay(100);
}
  
```

Fig.2 Actual code used to set actions.

C. Design and Implementation

• Power Supply

Conversion of 9 volt into 5 volt and 5 volt into 3.3 volt.

• H-bridge

The motor driver controller is based on L298D The left motor is connected to input 1 and 2 while the right motor is connected to input 3 and input 4. Enable pin of L298D is connected to the digital pin number 6 of Arduino Uno for speed control.

• HC-05 and HC-SR04

The RX which is digital pin 0 of Arduino UNO is connected to TX pin of Bluetooth module HC-05 while RX pin of HC-05 is connected to TX of Arduino UNO, digital pin

1. Ultrasonic sensor used for obstacle detection and avoidance is HC-SR04. It measures distance which extends in the range up to 400cm with accuracy. It consists of ultrasonic transmitter, receiver and the control circuit and has worked by sending pulse and check echo to determine the distance of the obstacle. Emitter and detector of Ultrasonic sensor are able to produce 40 kHz sound wave and detect same frequency as well as sends electrical signal back to the microcontroller.



Fig.3 The working HCVR

D. Hardware Used

- **Arduino UNO**

The Arduino Uno is an open-source microcontroller. A microcontroller is a compact IC designed to do a specific task in a system. The role here is to respond to the read commands accordingly, which are pre-programmed in the microcontroller and is linked with the motor driver. The Uno is a micro-controller board based on the ATmega328P chip having 14 digital input/output pins, 6 analogue inputs. It also contains 16 MHz quartz crystal, a USB connection, a power jack, an ICSP header and a reset button.

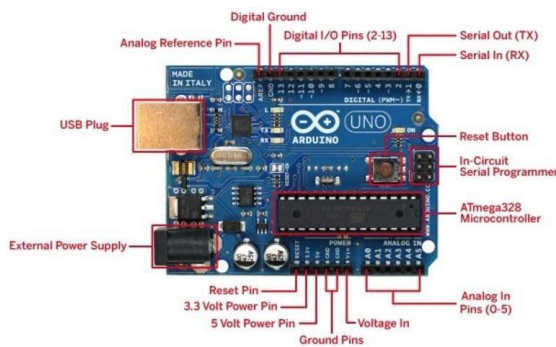


Fig.4: Arduino Pin Diagram. [2]

- **Bluetooth Module HC-05**

HC-05 is a Bluetooth module used to establish wireless communication. It can be used in a master or slave configuration. The red LED indicates connection status, whether the Bluetooth is connected or not. Before connecting to the module this red LED blinks continuously in a periodic manner. When it gets connected to any other Bluetooth device, its blinking slows down to 2 seconds. The module works on 3.3 V. We can connect up to 5V supply voltage as well since it has on board 5 to 3.3 V regulator. The RX/TX pins work on 3.3 V level and microcontroller can detect 3.3 V level.

- **L298D Bridge**

The L298 Driver is also called as H-bridge. It is high voltage and high current dual bridge driver. The design is to accept standard Transistor-Transistor logic (TTL) levels. It is basically used to drive DC and stepper motors. It has two enable pins provided to enable or disable the device. This module can drive DC motors having voltage range from 5 to 35 V and can bear peak current up to 2 A. This driver allows you to control the direction and working speed synchronously.

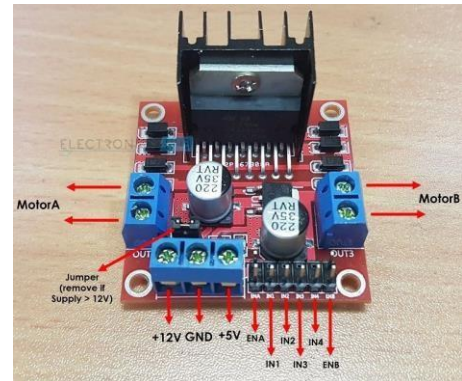


Fig.5: L298D Pin Diagram.[3]

- **HC-SR04 Ultrasonic Sensor**

HC-SR04 distance sensor is commonly used with both microcontroller platforms like Arduino, Raspberry Pie etc. The sensor used for detecting the distance to an object using sonar. It uses non-contact ultrasound sonar to measure the distance to an object, and consists of two ultrasonic transmitters (basically speakers), a receiver, and a control circuit. A high frequency ultrasonic sound is emitted by the transmitters which reflects back from any nearby obstacle, and the receiver listens for any return echo. To calculate the time difference between the signal being transmitted and received echo is processed by the control circuit this time can subsequently be used, to calculate the distance between the sensor and the reflecting object.



Fig.6: Ultrasonic Sensor HS-SR04. [4]

- **DC Motors**

A DC Motor is a direct current power motor. The operation is dependent upon simple electromagnetism. A conductor that carries the current generates a magnetic field, then it is placed in an external magnetic field. It encounters a force that is proportional to the current in the conductor and to the strength of the external magnetic field. It is also used to convert electrical energy to mechanical energy. It works on the fact that a force causes the conductor to rotate with respect to its original position.



Fig.7: DC Motor [5]

E. Software Used

- **Arduino IDE**

The Arduino Integrated Development Environment - or Arduino Software (IDE) - contains a text editor for writing code, a message area, a text console, a toolbar with buttons containing common functions and a series of menus. The programs are then uploaded to the Arduino hardware. Programs written are called sketches which are written in the text editor and are saved with the file extension (.ino). The editor provides features such as cutting/pasting and searching/replacing text. The message area gives feedback while saving and also displays errors. The console displays text output by the IDE. The configured board and serial port are displayed at the bottom right-hand corner of the window. The verification and uploading of the programs, creations, opening, and saving sketches, and opening the serial monitor can be done using the buttons of the toolbar.

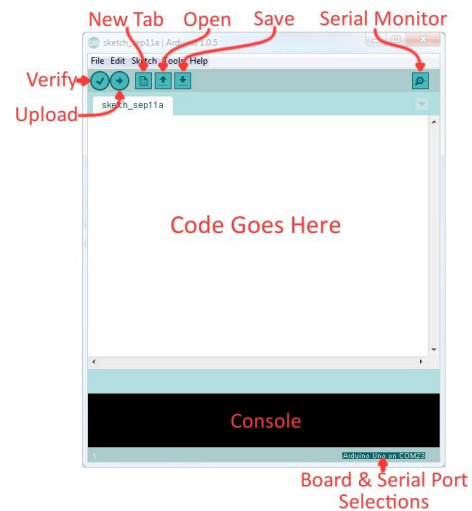


Fig.8: Arduino IDE [6]

- **Android Application**

The Android Application lets you connect to HC-05 module via Bluetooth and allows you to send signals to the Arduino so that it can perform desired operations successfully. The Application sends 5 signals, numbers from 1 to 5 that are used to prepare a sandwich deal accordingly.

IV. BLOCK DIAGRAM

The Bluetooth module is connected to the android application which from which the Arduino reads commands. After processing them the Arduino activates motors accordingly with the help of motor driver L298D. A battery is used to power the whole robot.

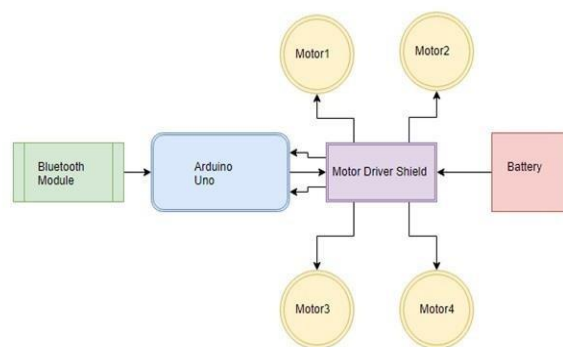


Fig.9: Block Diagram. [7]

CONCLUSION AND FUTURE SCOPE

- We can say that Voice controlled robots can certainly dominate the future market for many industrial and domestic purposes related to automating daily tasks
- Though it requires several tests but the robot works quiet well with very less errors in recognizing voice commands

- Little modifications in the android application can result in a much more clarity in voice recognition
- For advancements in this research work we can use a long-ranged module which will result in connectivity with the robot for long distances and as a result overcome its limitation.
- Power Optimization algorithms can be used.
- Best for handicapped people who can rely on this robot as there is very less chance of accident. The robot will stop instantly by slowing down once identifies an obstacle.
- This Internet of Things product gives a completely new direction to robotics.
- As an application it can be used for military purposes where the commands can be given to robot without any risk of increasing the range and we can install cameras on the robot to get enemy view.
- Can also be used for Home Security purpose with installed cameras.

- Use of Artificial Intelligence along with voice commands will take this research to a new dimension

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