

Arduino Based Speech Controlled Robot for Human Interactions

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ABSTRACT - In this paper, Arduino based speech controlled robot can be operate in manufacture line process, automobiles and for physical disable persons. Today many electronic devices are available to reduced the mechanical work of humans, in that speech controlled robot(SCR) is one. The main aim is to recognize the human voice and commanding the robot accordingly. Speech recognition software is used to recognize voice. The project is of two types: one for smart-phone application type and other is for hardware implementation type. Smart-phone application is developed in smart-phones with a controller. Hardware application involves the construction of components like Arduino UNO, Bluetooth module, DC motors, batteries, etc. This system is programmed using Embedded C language for controlling mechanism of robot.

Key words: automobiles, speech recognition, Embedded C language, physical disable persons, smart-phone application, hardware implementation

1. Introduction:

Nowadays robots are developed rapidly and are used for social public services. It is also used in automobile industries and physical handicapped persons. If robot handling is easier then more number of people can use it. For that purpose only communication between humans and robots, speech is the much simple and easier. Apply speech to control robot is much easy. The operator only needs to speech the command for specific task. In this paper, speech recognition is used for humans to control the robot[1].

In previous years, so many researches have been developed to improve the robotic operations some of them are

1) R. Pahuja and N. Kumar proposed an Android application based on touch screen to control a robot using micro-controllers[2].

2) S. kumar proposed a low cost smart home system. This system integration of smart-phone application communicate with micro-web server for providing remote service access and switching function[3].

Generally 5 basic commands are used they are Forward, Backward, Left, Right, Stop. For any specific application like to build a car some more commands are used like Buzzer/Horn, Turn on lights,..etc. Speech controlled robot system is very beneficial in areas where there is a high risk for humans to enter. SCR is controlled through speech commands received via smart-phone devices. The communication between smart-phone and receiver is a serial communication data. Arduino program is designed in such a way that to motor through motor driver circuit as per the commands sent by smart-phone devices.

In this project ultrasonic sensor is used at the front of the robot used for obstacle detector to protect the system from obstacles or objects. The buzzer/horn and LED lights are used for security purpose in special applications such as in automobiles.

Speech controlled robot is controlled Bluetooth hc-05 via smart phone. The app is developed in the smart-phone which is used for converting speech/voice into text. Smart-phone Bluetooth is paired to the Arduino Bluetooth. Transfer the text from smart-phone to paired device. The Arduino Bluetooth receives the text and stores it as assign string. The pre-programmed words such as Forward, Back, Left, Right, and Stop in Arduino. If received text is matched to the pre-programmed words then Arduino starts executing the commands.

2. Working :

This project involves in the smart-phone application and hardware implementation. Smart-phone application involves in the speech recognition and robotic vehicle. This speech recognition converts voice into text and transfer as serial bits of data. Data is received in robotic vehicle through Bluetooth[4].

2.1 Operation:

Here, person speak a word to smart-phone, the system match the word with the pre-programmed, if there is a matching word in the pre-programmed then robot will make a response movement. The software used in smart-phone is BT Voice Control for Arduino to recognize the voice. The pre-programme is develop using a Embedded C language.

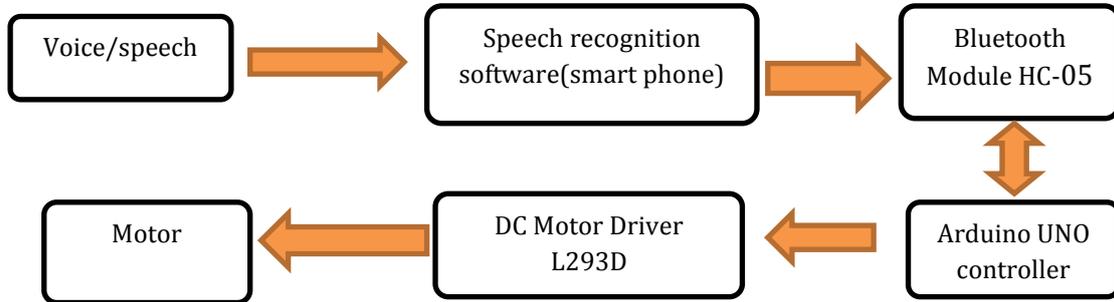


Fig.1 Block diagram for the operation

In fig.1 the person has to give the voice commands, that commands are recognized by the speech recognized software in smart phone and transfer through Bluetooth. At receiver side the Arduino UNO is used to controller those commands and sends to Motor Driver shield to control the robotic vehicle through Motors.

In fig.2 flow chart of operation is shown, as explained above first speech recognition is done. There after speech recognition output(text) is verified. If commands in the output is as same as the pre-programmed commands then command matched. If Command matched is yes then robotic vehicle is activated and move accordingly. If it is not matched then software displayed as Access Denied.

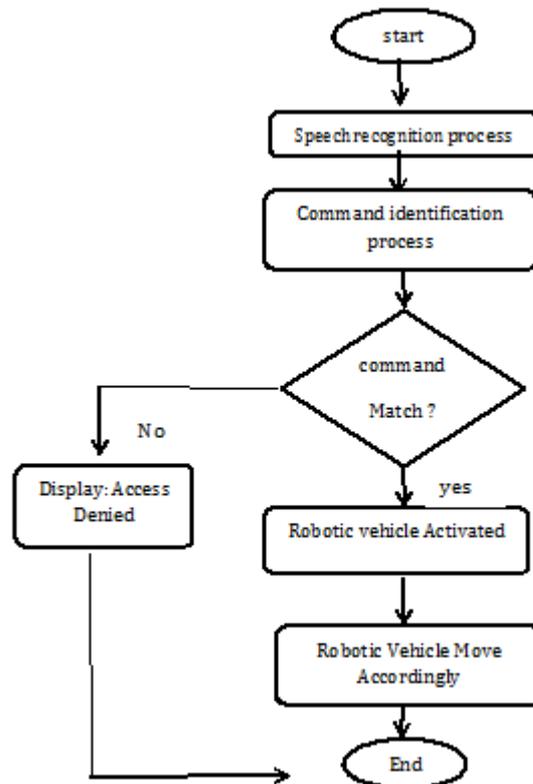


Fig.2 Flow chart of the operation

2.2 Hardware Implementation:

In this project components mainly used are Arduino UNO, DC Motor Driver L293D, Ultrasonic Sensor, Bluetooth Module HC-05. Arduino UNO is a Micro-controller and it acts like a small computer. It has on-chip RAM, ROM, input/output ports, timer, serial

communication port. It is most widely used and user friendly. Simply connect the computer with a USB cable to Arduino board and upload the program. DC Motor Driver L293D is a quadruple high current drivers and supply voltage range is between 4.5V to 36V. It has high noise immunity inputs. Ultrasonic sensor is used front of robotic vehicle to measure the distance to an object using ultrasonic sound waves. The farthest range of this is 4m with an operating current of 15mA. For communication of robot with a smart phone, Bluetooth device is used. The Bluetooth HC-05 is attached to the robot that receives the data from the mobile and also can transmit the data. It is a wireless communication protocol running at 2.4GHz.

Using jumpers to connect the above components. Bluetooth HC-05 has four pins, they are VCC, GND, Rx, Tx.

- Connect VCC to 5V in Arduino board
- Connect GND to ground
- Module Rx to Arduino Rx
- Module Tx to Arduino Rx

If the Bluetooth module does not work make voltage divider using a 1K and 2K resistors and connect to Rx pin of the module to convert 5v to 3.3v.

The motor shield is attach to the Arduino board

- Left side of motors connect to the M3 and M4 terminals.
- Right side of motors connect to the M1 and M2 terminals.

After completion of all connections, a few instructions are used to operate the robotic vehicle. Some of them are:

Table 1: Task performed by the robotic vehicle

INPUT (Human voice)	OUTPUT (robotic vehicle)
Forward	Moves forward
Backward	Moves backward
Right	Turns right
Left	Turns left
Slow	Move slowly
Fast	Move fast
Light	Turn on light
Horn	Blow horn
Stop	Stop at current action

2.3 TESTING PROCESS:

During the test process, robotic vehicle makes real-time recognition and carry out the corresponding action. If the corresponding action makes the voice command, it means recognition result is correct. There are two types of environment: normal environment and noisy environment. Speech recognition perfectly works on normal environment and also recognition accuracy is 100 %, is shows in table 2. Where as in noisy environment the accuracy of speech recognition would be reduced. It shows in table 3.

Table 2. results in normal environment

SL.NO	Command	Test times	Correct times
1	Forward	10	10
2	Backward	10	10
3	Right	10	10
4	Left	10	9
5	Slow	10	10
6	Fast	10	9
7	Light	10	10
8	Horn	10	10
9	Stop	10	10

Table 3. results in noisy environment

SL.NO	Command	Test times	Correct times
1	Forward	10	9
2	Backward	10	8
3	Right	10	7
4	Left	10	8
5	Slow	10	6
6	Fast	10	8
7	Light	10	8
8	Horn	10	9
9	Stop	10	10

From this results, noise is the key factor which affects the speech recognition performance. Reducing the in environment is difficult task. However, it could be overcome in future[5][1].

2.4 ALGORITHM:

1. Voice commands are received to the smart-phone and stored.
2. Stored voice commands was converted into text in a binary format.
3. These binary format are transmitted through Bluetooth to receiver module.
4. At receiver side, micro-controller will take those binary values and perform actions according to that.

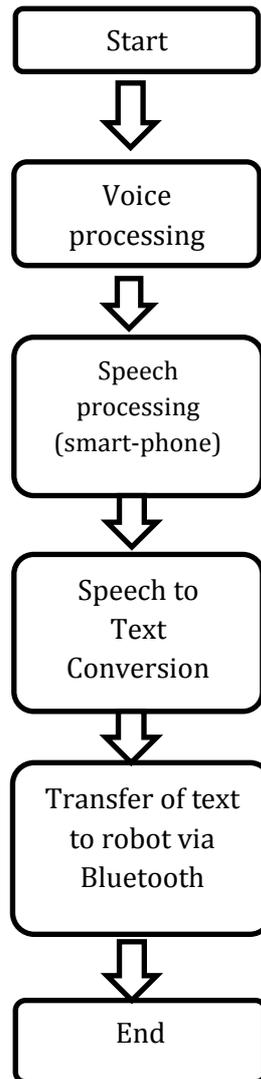


Fig .3 Algorithm for Arduino based speech controlled robot for human interactions

2.4 Scope for future work:

- By using long range modules will increase the long distance communication with robots.
- Need to be optimize power when robot is sleep.
- Implementing image processors and face detectors in robot to detect the color, object and faces.
- Implementing speech recognition more accurately.
- For tracking targets automatic traget system will be implemented.

3. Conclusion :

In this paper, robot can understand control commands spoken in a natural way and execute the corresponding action. The function of robot is fully controlled by the voice from smart phone. This method is proved in real-time operation. This can be used where there is a high risk for humans to enter.

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