Voice Controlled Robotic Vehicle with Long Distance Speech Recognition

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Abstract- Speech is a ideal method for robotic control and communication. The speech recognition circuit we will outline, functions independently from the robot's main intelligence [central processing unit (CPU)]. This is a good thing because it doesn't take any of the robot's main CPU processing power for word recognition. The CPU must merely poll the speech circuit's recognition lines occasionally to check if a command has been issued to the robot. We can even improve upon this by connecting the recognition line to one of the robot's CPU interrupt lines. By doing this, a recognised word would cause an interrupt, letting the CPU know a recognised word has been spoken. Another advantage to this stand-alone speech-recognition circuit (SRC) is its programmability. You can program and train the SRC to recognise the unique words you want recognised. The SRC can easily interface to the robot's CPU. At its most basic level speech origination allows the user to perform parallel tasks, while continuing to work with the computer or appliance. The algorithm which is going to be used is Forward Algorithm or Viterbi Algorithm. Forward algorithm solves given model parameters which have output probability as a certain series of number. Viterbi algorithm solves given model parameters which have hidden state series with maximum probability to give output as a given certain series of number.

Index term- *mobile robot , Smartphone,remote control , Interfacing Circuit.*

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I. INTRODUCTION

The purpose of this project is to build a robotic car which could be controlled using voice commands. Generally these kinds of systems are known as Speech Controlled Automation Systems (SCAS). Our system will be a prototype of the same. We are not aiming to build a robot which can recognize a lot of words. Our basic idea is to develop some sort of menu driven control for our robot, where the menu is going to be voice driven. What we are aiming at is to control the robot using following voice commands. Robot which can do these basic tasks like move forward, movie backward,move left,move right.

The greatest advantage of using a mobile phone to remotely control a robot is location independent.There are a number of existing articles studying the development of communication models between a cellular phone and a robot. Smartphones to be powerful platform for robotic automated remote control. A contemporary smartphone possesses many auxiliary features.

II. DESIGN OF ROBOT SPEECH COMMAND CONTROL SYSTEM

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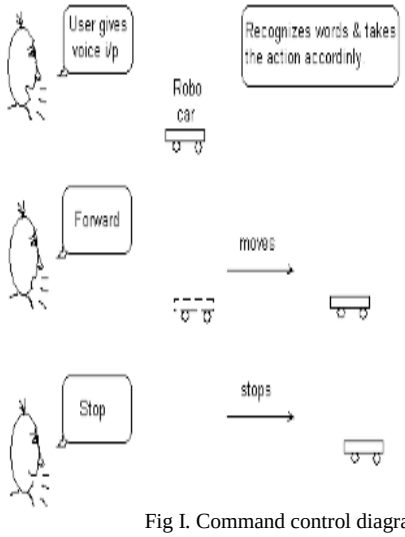

Fig I. Command control diagram

The process of speech commands controlling is complicated. When the operator speaks to the robot, their voice will be captured by the microphone and passed into signal processing module. Oral commands will be processed into a structure of features. These features may include signal characteristics such as energy or frequency response. The features would be analysed and compared with the data in database. The database is obtained through signal analysis, that stage can be

called "training" of the speech data. The recognized commands will be passed into control module, which is separate from the speech recognition module. The control module will process the commands it receives from the speech recognition module and instruct the robot to take corresponding actions.

There are four basic commands: go forward, go backward, turn left, turn right, and stop. All the commands would be given to the control module. There is a while loop to keep checking the input command, and compares it with those seven basic commands. If the command is one of them, then the control module will make the robot take the corresponding action. Turn left command means the robot will turn left 45 degrees and then go straight with a constant velocity of 0.05m/s.The same extent to the turn right command. Extend and reposition means two position of manipulator. Go forward and go backward means it will go straight with a constant velocity of 0.05m/s. Stop means the robot will pull up without any action.

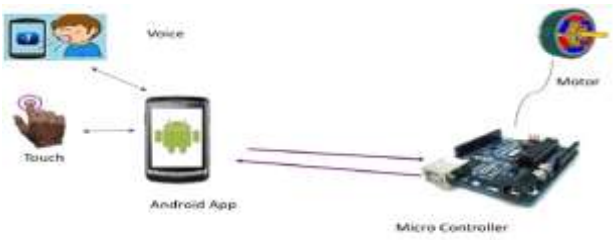

Fig II. Working

III. VOICE COMMAND RECOGNITION

Speech signal is time variable actually. We usually process speech signal in a very short time, for instance, in 20ms, such a short time, the signal can be considered invariable, and this is the basic point of processing of speech signal.

The process of our speech recognition is to extract feature from an acoustic signal and then recognise it. Feature extraction step involve Mel Frequency Campestral Coefficients (MFCC) and the linear prediction coefficients (LPCC). The MFCC parameter achieves the highest recognition accuracy when compared with LPCC. The recognition stage can be achieved by many processes such as Dynamic Mme Warping (DTW) which is based on pattern-comparison, Hidden Markov Modelling (HMM) which is based on statistics model, Neural Networks (NN) which is based on neural network .

In some small vocabulary application, the speech recognition that is based on pattern-matching is more convenient and efficient than the other algorithms. The more simple control commands are, the more intelligent a robot should be. Simple isolated words speech recognition technique can give highest accuracy of recognition results in shorter time requiring less powerful hardware. So DTW is appropriate for small vocabulary and real time operation. In process of speech recognition using DTW, features which represent the voice would be extracted and then be compared with the data in database. The database is obtained through signal analysis, that stage can be called "training" of the speech data.

Considering for our system, we need real time operation and our commands are simple, so speech recognition technique DTW which is based on pattern-comparison is selected, and we extract MFCC as feature of the speech command.

In our system, the process of speech recognition can be divided into five parts:

1. Acquire voice signals through microphone and make analog-to-digital conversion through soundcard
2. A series of pre-process signal analysis
3. Mel Frequency Campestral Coefficients (MFCC) calculation [1]

IV. EXISTING SYSTEM

The Existing voice controlled robot uses a wide range of techniques for feature extraction. Any one of the techniques can be used to develop the system. The techniques are as follows:

A. USING 8951 MICROCONTROLLOR AND RF MODULATOR

The main objective of the project is to control the robotic vehicle in a desired position, remotely through user voice commands by attaching a speech-recognition module to the microcontroller unit and using an RF communication. The proposed system consists of two blocks: transmitter and receiver block; both use a microcontroller of the 8951 family and a battery for power source. This project also consists of a laser beam light to diffuse the bombs if required from a certain distance. An RF transmitter module is connected to the transmitter unit with the help of an encoder device. A voice-recognition module and a set of push-button switches are interfaced to the microcontroller for giving the input. The commands are sent from the voice or push-button switches to the receiver to control the movement of the robot either in forward, backward left or right directions. An RF receiver is connected to the receiver end with the help of a decoder device. The two motors are interfaced to the microcontroller through a motor-driver IC wherein they are used to run or change the directions of the robotic vehicle. The robot is controlled by the voice or push buttons wherein the commands are sent by the transmitter –and, based on these commands –the receiver controls the directions of the robot. A laser beam is mounted on the robot's body – whose operation is carried out by the microcontroller output through the appropriate signal from the transmitting end.

B. VOICE CONTROLLED ROBOT USING ANDROID MOBILE BLUETOOTH

Voice Controlled Robot (VCR) is a mobile robot whose motions can be controlled by the user by giving specific voice commands. The speech recognition software running on a Android Mobile is capable of identifying the different voice commands 'Forward', 'Stop', 'Left', 'Right' and 'Back' etc. Issued by a user. The working mechanism of the robot is

based on the information passed from the Phone to the robot using a headset cable. If u want to use online mode u can directly use common commands like forward, backward, left, right or if u want to use offline mode u have to use below commands.

Commands for online mode
go = forward
back = back
left
right
stop

these commands can be easily understood by Google server for voice recognition input so we used these commands.

C. CONTROLL ROBOT BY USING MOBILE DTMF TONE (TOUCHPAD) AND ATmega16 MICROCONTROLLER

In this project, the robot is controlled by a mobile phone that makes a call to the mobile phone attached to the robot. In the course of a call, if any button is pressed, a tone corresponding to the button pressed is heard at the other end of the call. This tone is called 'dual-tone multiple-frequency' (DTMF) tone. The robot perceives this DTMF tone with the help of the phone stacked in the robot. The received tone is processed by the ATmega16 microcontroller with the help of DTMF decoder MT8870. The decoder decodes the DTMF tone into its equivalent binary digit and this binary number is sent to the microcontroller. The microcontroller is pre-programmed to take a decision for any given input and outputs its decision to motor drivers in order to drive the motors for forward or backward motion or a turn.
The mobile that makes a call to the mobile phone stacked in the robot acts as a remote. So this simple robotic project does not require the construction of receiver and transmitter units.

DTMF signalling is used for telephone signalling over the line in the voice-frequency band to the call switching centre. The version of DTMF used for telephone tone dialling is known as 'Touch-Tone.'

D. CONTROLL ROBOT USING PLAYSTATION CONTROLLOR

The PlayStations game port uses a rather sophisticated protocol built on top of a very simple and common serial interface: SPI. This synchronous serial interface uses four lines: a clock (sent by the Adriano), a data input (called MISO), a data output (MOSI) and a select (sometimes called SS or ATT). This interface is byte oriented and a basic transfer consist of an exchange of eight bits. There are several parameters that need to be agreed upon before a successful link can be established (speed, data order, clock polarity and active clock edge). However, you don't need to worry about these too much as the library sets up the Adriano to match the format used by the PlayStation.

There is one difference between Arduino and a Playstation: while Arduino runs at 5V, the Playstation (and its peripherals) are designed to run at 3.3V. Some people have successfully run some of these game pads at 5V, however I am not sure how reliable such a setup would be for the long term. As the drawing below shows, I decided to use a special chip (the TXS0104, Available from Digi-Key) to adjust the logic levels between the Arduino and the Playstation plug. This chip is very easy to use: just power VCCb at 5V and VCCa at 3.3V and you are done! Please note that a previous version of this page had VCCa and VCCb reversed. Thanks to Joonas for pointing out my error. Each of the four channels is fully bi-directional without a need to select the direction.[6]

V. SYSTEM ANALYSIS

A. FEASIBILITY ANALYSIS

Feasibility study is a major factor that contributes to the analysis of the system. The decision of the System Analyst, where to design a particular system or not depend on its feasibility study. The feasibility study on this system is divided in the following three areas. All projects are feasible given unlimited resource and infinite time. It is both necessary and prudent to evaluate the feasibility of the project at the earliest possible time. Feasibility and risk analysis is related in many ways. If project risk is great, the feasibility listed below are equally important.

1) *Economic Feasibility:* This is concerned with the cost incurred for development and implementation of the system, the maintenance of the system and the benefits derived from it. The hardware and software required for the system is already available. In this we examine the cost of developing the system with regard to what the organization can afford. The only cost involved is for coding, implementation and maintaining of the system. Hence the system is economically feasible.

2) Technical Feasibility: The firm has to purchase a machine with Pentium processor or higher. The computer must be running windows XP or any other higher version of windows. As the hardware and the software of developing the system is already available, the system is technically feasible. The concern will only be in which system the software is being developed and in which it will be implemented. The proposed system is developed in KEIL µVISION and ECLIPSE and will be implemented on android 4.0 or above. The project is beneficial only if it can provide a successful and accurate access to the users.

3) Operational Feasibility: There are two aspects to operational feasibility. One aspect is that of technical information and other is Acceptance. Technical information determines if a system can provide correct results and Acceptance involves users acceptance to the computer system. Knowing that the system can provide easy and accurate access to a robotic vehicle, users will not hesitate to use the system for real situations in daily routine. The current system also provides options for speech recognition technique to control the bot but is less accessible and has a less coverage area. Thus the system that is going to be developed will be highly accurate and can process the voice signals at a much faster rate. With better algorithms the software is assured to give better results without compromising in the genre of quality on accessibility

B. REQUIREMENT ANALYSIS

1) User interfaces: User interface is simple and efficient enough to set up the user's voice. Apart from this user interface need not be used as the application runs in the background.

2) Hardware interface: Any smart phones working at android 4.0 or above.
Processor above 500 MHz and 512 MB of RAM
Internal memory with at least 100 MB free storage.
Steel chassis with mobile holder.

3) Performance requirements: The maximum satisfactory time to respond to the voice and accessing the bot should be less than a second. Response time can be measured from the time the user speaks to the phone to the time the vehicle takes to start its moment. It is user's subjective wait time.
The user if suffering from tracheal infections might not be able to access the vehicle and might have to resent to the basic techniques of accessing the vehicle such as using RF module or Bluetooth control.

4) Security requirement: It has to be ensured that the saved information on the speech recognition app is not tampered by another program, software or virus intentionally or unintentionally.

C. SOFTWARE QUALITY ATTRIBUTES

Quality attributes are the overall factors that affect run-time behaviour, system design and user experience. They represent the areas of concern that have the potential for application wide impact across layers and tiers. Some of these attributes are related to the overall system design, while others are specific to run time, design time, or user related issues. The extent to which the application possesses a desired combination of quality attributes such as usability performance, reliability and security indicates the success of the design and the overall quality of the software application. When designing applications to meet any of the quality attribute requirements, it is necessary to consider the potential impact on other requirements. One must analyze the tradeoffs between multiple quality attributes. The importance or priority of each quality attribute differs from system to system.

1) Functionality : Recognising the voice commands, processing the commands according to the moments and fetching it to the robotic vehicle.
2) Reliability : Maturity and accuracy.
3) Usability : Fast processing and moving robotic vehicle according to command.
4) Efficiency : Accurate matching and quick processing.
5) Maintainability : None except for factory updates.

D. SYSTEM ANALYSIS

After analysing the requirements of the task to be performed, the next step is to analyse the problem and understand its context. The first activity in the phase is studying the existing system and other is to understand the requirements and domain of the new system. Both the activities are equally important, but the first activity serves as a basis of giving the functional specifications and then successful design of the proposed system. Understanding the requirements of a new system is more difficult and requires creative thinking and understanding of the existing system is also difficult, improper understanding of present system can lead diversion from solution.

VI. Conclusion

In this paper a method of word speech recognition system was proposed to control the vehicle and therefore make proposed technique be more efficient in real time operation used in control. In our proposed project

In this paper the hardware used for making of the vehicle is also presented and the android app working which will control the robot .The communication channel which will carry the signal will be 2 types that is cellular connection for word recognition internet connection and for clear connection to the robot instead of using a analog connection we have used a digital connection that is via bluetooth .

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