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Acoustic Controlled Robotic Vehicle

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***Abstract*— This paper presents a robotic vehicle that can be operated by the voice commands given from the user. Here, we use the speech recognition system for giving &processing voice commands. The speech recognition system use an I.C called HM2007, which can store and recognize up to 20 voice commands. The R.F transmitter and receiver are used here, for the wireless transmission purpose. The micro controller used is AT89S52, to give the instructions to the robot for its operation. This robotic car can be able to avoid vehicle collision , obstacle collision and it is very secure and more accurate. Physically disabled persons can use these robotic cars and they can be used in many industries and for many applications**

***Keywords*—SpeechRecognitionSystem,AT89S52 micro controller, R. F. Transmitter and Receiver.**

I. INTRODUCTION

The field of robotics encompasses a broad spectrum of technologies in which computational intelligence is embedded in physical machines, creating systems with capabilities far exceeding the core components alone. Such robotic systems are then able to carry out tasks that are unachievable by conventional machines, or even by humans working with conventional tools [1-4].

Robots are indispensable in many manufacturing industries. The reason is that the cost per hour to operate a robot is a fraction of the cost of the human labour needed to perform the same function. More than this, once programmed, robots repeatedly perform functions with a high accuracy that surpasses that of the most experienced human operator. Robots are built and programmed to be job specific. Robots are in the infancy stage of their evolution. As robots evolve, they will become more versatile, emulating the human capacity and ability to switch job tasks easily.. Robots require a combination of elements to be effective: sophistication of intelligence, movement, mobility, navigation, and purpose.

A. *Over view:*

- Problem
- Solution

1) Problems of already existed vehicles:

Problems caused due to the existed vehicles are- Not useful to the disabled persons, Obstacle collision, No security to the vehicles, Control complexity [5-8].

2) Solution:

The solution for all the above problems that are caused by the existing vehicles can be given by the "voice controlled robotic vehicle". By this voice controlled robotic vehicle, we can reduce control complexity, avoid obstacle collision Provide security to the vehicles.

Voice Controlled Robot (VCR) is a robot whose motions can be controlled by the user by giving specific voice commands. The speech recognition is capable of identifying the 5 voice commands 'Run', 'Stop', 'Left', 'Right' and 'Back' issued by a particular user.

What we are aiming at is to control the robot using following voice commands.

Robot which can do these basic tasks:

1) move forward
2) move back
3) turn left
4) turn right
5) Stop

The speech recognition is speaker dependant. The special feature of the application is the ability of the speech module to train itself for the above voice commands for a particular user [9-12].

After processing the speech, the necessary motion instructions are given to the robot via a RF link. R.F. link consists of R.F. transmitter and R.F receiver for wireless transmission [13-14].

II. SPEECH RECOGNITION

Voice enabled devices basically use the principal of speech recognition. Speech recognition is the process of converting an acoustic signal, captured by micro-phone or a telephone, to a set of words.

There are two important parts in Speech Recognition

1) Recognize the series of sound and
2) Identify the word from the sound.

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This recognition technique depends also on many parameters-Speaking mode, Speaking Style, Speaker enrollment, Size of the Vocabulary, Language Model, Perplex- ity, Transducer etc. Converting a speech waveform into a sequence of words involves several essential steps:

1) A microphone picks up the signal of the speech to be recognized and converts it into an electrical signal. A modern speech recognition system also requires that the electrical signal be represented digitally by means of an analog-to-digital (A/D) conversion process, so that it can be processed with a digital computer or a microprocessor.
2) This speech signal is then analyzed (in the analysis block) to produce a representation consisting of salient features of the speech. The most prevalent feature of speech is derived from its short-time spectrum, measured successively over short-time windows of length 20–30 milliseconds overlapping at intervals of 10–20ms. Each short-time spectrum is transformed into a feature vector, and the temporal sequence of such feature vectors thus forms a speech pattern.
3) The speech pattern is then compared to a store of phoneme patterns or models through a dynamic programming process in order to generate a hypothesis (or a number of hypotheses) of the phonemic unit sequence. (A phoneme is a basic unit of speech and a phoneme model is a succinct representation of the signal that\ corresponds to a phoneme, usually embedded in an utterance.) A speech signal inherently has substantial variations along many dimensions. Before we understand the design of the project let us first understand speech recognition types and styles.

III. STRUCTURE AND DESIGN OF THE VEHICLE

The hardware structure of the voice controlled robotic car consists of two parts

1) Transmitter part
2) Receiver part

The transmitter and the receiver parts of the robot are communicated using wireless communication.

A. *Transmitter part of the robot:*

The Transmitter part of the robotic car is the combination of two systems.

1) Speech recognition system.
2) R.F. Transmission circuit.

1). Speech recognition system:

The process of a machine's listening to speech and identifying the words is called Speech Recognition System.

The speech recognition system is a completely assembled and easy to use programmable speech recognition circuit. Programmable, in the sense that we train the words (or vocal utterances) we want the circuit to recognize. This board allows us to experiment with many facets of speech recognition technology. 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.

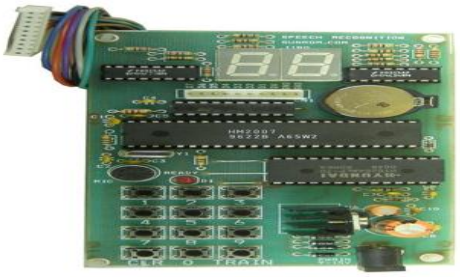

Fig. 1 Speech recognition module

The features of speech recognition system are-self-contained stand alone speech recognition circuit, User programmable, Up to 20 word vocabulary of duration two seconds each, Multi-lingual, Non-volatile memory back up with 3V battery on board. Will keep the speech recognition data in memory even after power off, easily interfaced to control external circuits & appliances.

The heart of the circuit is the HM2007 speech recognition IC. The IC can recognize 20 words, each word a length of 1.92 seconds, the keypad and digital display are used to communicate with and program the HM2007 chip. The keypad is made up of 12 normally open momentary contact switches. When the circuit is turned on, "00" is on the digital display, the red LED (READY) is lit and the circuit waits for a command.

a. Training Words for Recognition:

Press "1" (display will show "01" and the LED will turn off) on the keypad, then press the TRAIN key (the LED will turn on) to place circuit in training mode, for word one. Say the target word into the onboard microphone (near LED) clearly. The circuit signals acceptance of the voice input by blinking the LED off then on.

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The word (or utterance) is now identified as the "01" word. If the LED did not flash, start over by pressing "1" and then "TRAIN" key

We may continue training new words in the circuit. Press "2" then TRN to train the second word and so on. The circuit will accept and recognize up to 20 words (numbers 1 through 20). It is not necessary to train all word spaces. If we only require 10 target words that are all we need to train.

b. Testing Recognition:

Repeat a trained word into the microphone. The number of the word should be displayed on the digital display. For instance, if the word "directory" was trained as word number 20, saying the word "directory" into the microphone will cause the number 20 to be displayed.

c. Error codes:

The chip provides the following error codes.
55 = word to long
66 = word to short
77 = no match

d. Clearing memory:

. To erase all words in memory press "99" and then "CLR". The numbers will quickly scroll by on the digital display as the memory is erased.

e. Changing and erasing words:

Trained words can easily be changed by overwriting the original word. For instances suppose word six was the word "Capital" and you want to change it to the word "State". Simply retrain the word space by pressing "6" then the TRAIN key and saying the word "State" into the microphone.

If one wishes to erase the word without replacing it with another word press the word number (in this case six) then press the CLR key. Word six is now erased.

f. Learning to listen:

The ability to listen to one person speak among several at a party is beyond the capabilities of today's speech recognition systems. Speech recognition systems cannot (as of yet) separate and filter out what should be considered extraneous noise.

2).R.F. Transmission circuit:

R.F. Transmission circuit contains a microcontroller (AT89S52), an encoder (HT12E) and a R.F. transmitter.

The micro controller used here is,"AT89S52" for giving the instructions to the robot for its operation. The AT89S8252 is a low-power, high-performance CMOS 8-bit microcontroller with 8K bytes of downloadable Flash programmable and erasable read-only memory and 2K bytes of EEPROM.

Sample code:

:

Fig. 2 Forward sub routine.

. Fig. 3 Backward sub routine

Fig. 4 Stop sub routine

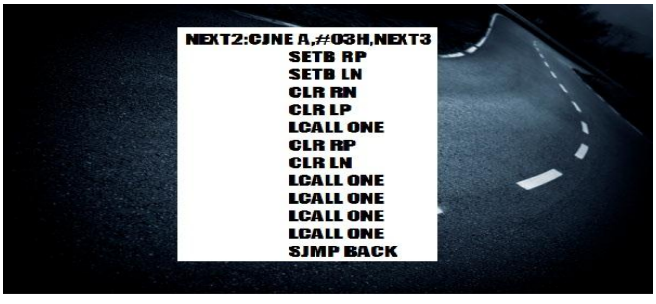

Fig. 5 Left sub routine

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Fig. 6 Right sub routine

The encoder used here is,"HT12E" for encoding the data coming from the micro controller, and to send the data to R.F. Transmitter. Here, we use 433 MHz RF Transmitter STT-433 for transmission purpose.

B. *Receiver part of the robot:*

The Receiver part of the robotic car is the combination of R.F. Receiver, Decoder(HT12D),Motor control circuit. Here, we use 433 MHz RF Receiver STT-433 for reception purpose. The decoder used here is,"HT12D" for decoding the data coming from the R.F. Receiver, and to send the data to motor control unit. A variety of electric motors provide power to robots, making them move with various programmed motions. The efficiency rating of a motor describes how much of the electricity consumed is converted to mechanical energy. The motor driver ic used here is, L293D.

C. *Interfacing the robot:*

The transmitter part of the robot and the receiver part of the robot are communicated by using wireless communication. Typically, communication in modular robots is based on infrared or wired communication. The main problem of infrared and wired communication is that modules need to accurately align and orient to perform communication, which is especially problematic during connection and disconnection of modules. The environment also represents a problem for infrared and wired communication since dust and dirt can abrade or obstruct the infrared optics and, for wired communication, prevent electrical connections. These limitations have motivated the use of wireless communication technologies.

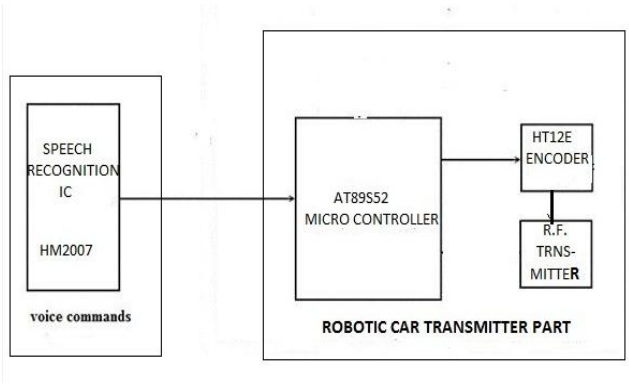

Fig. 7 Robotic car transmission part

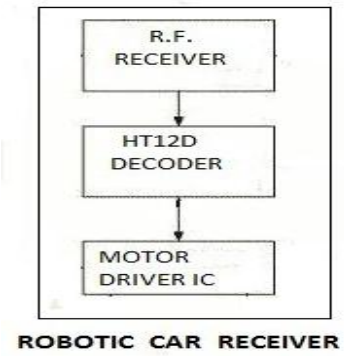

Fig. 8 Robotic car receiver part (robot body)

IV. Discussion And Results

This Project mainly consists of Voice recognition system and Communication system. The program was able to recognize five commands 'forward', 'reverse', 'stop', 'turn left', 'turn right' .

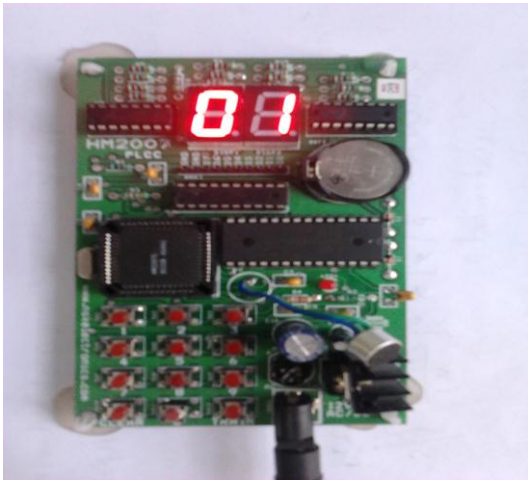

Fig. 9 Speech recognition circuit

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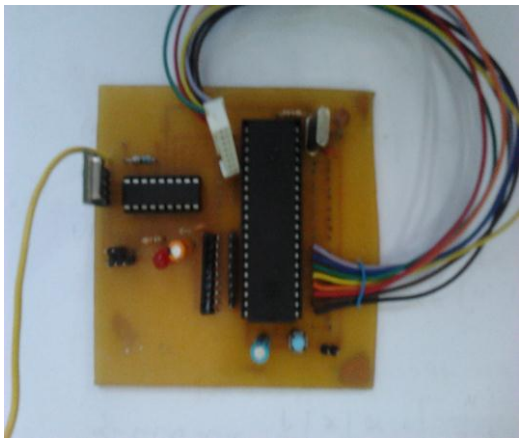

Fig. 10 RF Transmitter circuit

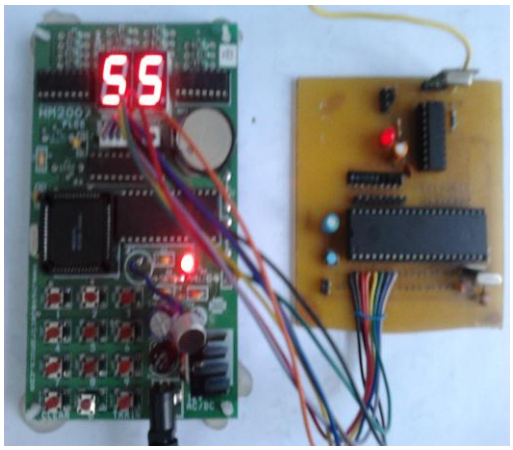

Fig. 11 Robotic car Transmitter circuit

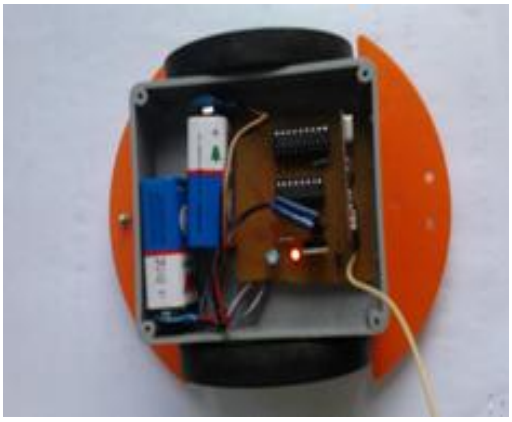

Fig. 12 Acoustic controlled Robotic car

V. CONCLUSION

Speech Recognition System possesses a higher recognition rate in low noise environment. The speech recognition circuit has accuracy around 75% in correctly identifying a voice command. But it is highly sensitive to the surrounding noises. There is a possibility of misinterpreting some noises as one of the voice commands given to the robot. Also the accuracy of word recognition reduces in face of the noise. The sound coming from motors has a significant effect on accuracy.

The voice-controlled smart car designed can be regarded as a model of Auto control. It could be widely used in various automated control systems if continuing to improve its function. When making some minor changes, it could be used to control air-conditioner, video recorders and other electrical appliances Fig.20 is the picture of acoustic controlled robotic car.

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