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Embeeded Automatic Vehicle Control System Using Voice Recognition On ARM 7 Processor

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Abstract: This paper gives the design and implementation of embedded system for voice recognition in automatic vehicle driving using ARM cortex A7 for physically challenged people. ARM cortex A7 has features such as low power consuming, low heat release than its predecessor (ARM A9) and based on ARM v7 architecture, also it is a quad core processor and the system uses Google's speech API for the conversion of speech to text, which has the dictionary of phoneme for more than 60k words and many languages are supported.
Keywords: Voice control using ARM processor, embedded voice control driving, ARM 7 processor, L293d Motor Driver.

I. INTRODUCTION

The 2011 census showed that 1.2% of the total Indian population were physically challenged people in especially urban areas, their primary problem is transportation for their day to day life, even though there are many Companies like Mercedes, BMW are developing a solution for the problem using Voice recognition therefore to provide a complete automation, therefore we have been building an efficient voice recognition system for automated vehicle driving. There have many systems proposed throughout the discovery of voice recognition from the early 2000's for many applications.

Voice control system using DSPIC control can handle 256 words and it uses Radio waves transmission so the SNR calculation may delay the output or the signal may even got last [1], Voice control systems with local speech engine requires lot of tedious works for Acoustic model Building[2][5],As every speech recognition clearly should not uses more resources locally and it should has faster response time. Our paper tells the usage of google speech API for speech to text conversion which uses DNN-HMM for Acoustic model as it can handle any words up to the length of 100 characters and it also doesn't require user features in the spectrum of speech.

II. RELATED WORKS

A lot of research has been completed for Voice controlled Vehicle. Some of the recent research methods are discussed here.

Pradeep L. Yadav, Sanjay B.Deshmukh proposed a paper on Embedded Vehicle Control System based on Voice Processing using DSPIC [1] they used DSPIC microcontroller to provide voice control by receiving voice from user by 433 MHz transmitter and it provides efficient speech recognition for less than 256 words, and they uses hardware interrupt and the response time is very high because of the process such as HMM feature calculation for speaker dependent voice recognition and the HMM database formation is the tedious process because it requires lot of speech corpus to train the Acoustic model with several speakerS.Nareshkumar ,,N.Mariappan, .Thirumoorthy proposed a paper for Database Interaction Using Automatic Speech Recognition[2] which uses Sphinx4 voice recognition engine for speech to text conversion for interaction with database where it requires lot of training to build acoustic model for efficient speech recognition and it also overloads the processor because every word is recognized locally and user cannot have an option to customize the system upon his/her needs and it has more error rates even upon vigorous training of words and each sentences although it only has language model for only 335 words and 1212 sentences.

Suma Swamy and K.V Ramakrishnan proposed a paper for an Efficient Speech Recognition System [3], they had given that the use of HMM model for acoustic model may provide efficient speech and speaker recognition and it provides the base for many voice recognition applications and it collects the features such as MFCC for user speech with noise cancellation and it is followed by Vector Quantization (VQ) for HMM Database Generation Where lot of words can be recognized easily at efficient rate although it overloads the processor for simpler words with difficult phonemes and training of HMM requires a lot of speech corpus and tedious to collect that much of data .

Suhail more, Charudatta kulkarni proposed a paper on Design of Voice Controlled Vehicle System Using Arm7 Controller[4] and they uses PIC controller for transmitter section it collects the user voice as input and send to the Receiver section where it contains

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ARM7 controller and uses EasyVR module for voice recognition as with many predeccesors it only allows 32 commands although it may not require much of the processor resource ,of course with the support up to 32 commands does not support future enhancement.

III. PROPOSED SYSTEM

The proposed system mainly focuses on building an efficient voice controlling system for driving the vehicles for physically challenged people and additionally for controlling robots. The components used in the project are Raspberry pi 2 model B (ARM processor with 4 usb ports, 40 GPIO pins for interfacing with External devices and 5v micro usb slot for charging.) with internet connection L293d H-Bridge motor controller Driver, 2 BO motors, 9vBattery,Microphone and usb sound card(c-MediaThe Architecture for the proposed system is presented in the following figure 4.1

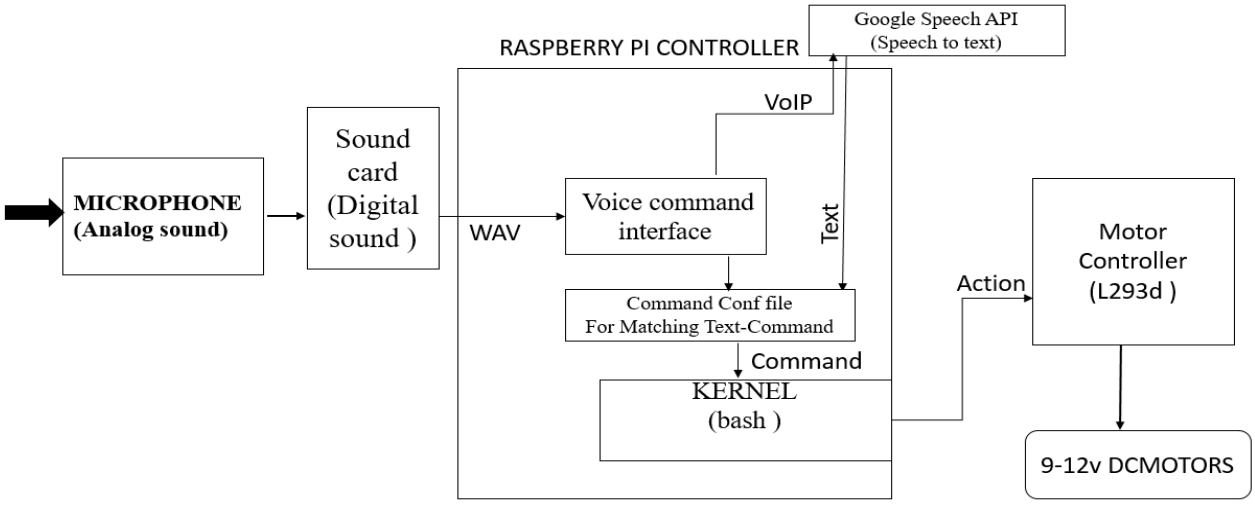


Fig 4.1 Architecture Diagram

The proposed system involves the following modules:

Speech recognizer

Motor Driver

A. Speech Recognizer
1) Features:

a) Uses Google Voice recognition API so it has accuracy over 81% and Provides Large Vocabulary Continuous Speech recognition (LVCSR) and it is fast enough because of using Machine Learning Neural Networks algorithm for Acoustic modelling.
b) It has Quad core 1GB RAM ARM A7 microcontroller Raspberry pi with Raspbian os.
c) It requires less power than its predecessors and also releases less heat.

The user voice is recorded with microphone and the Sound card converts the user speech into WAV Audio file by using the help of raspbian os on raspberry pi ARM7 microcontroller and then the converted file is stored in the temporary directory then our Application Voice command takes the WAV file as input with down sampling up to 16000Hz and the raspberry pi is connected to google voice API via internet which converts the speech to text and thus the API is effective in decoding because it uses Deep Neural Networks for Acoustic modelling instead of Regular HMM so it doesn't requires user features in speech as required with HMM and it process the speech and send the proper text command value to call a shell script to provide inputs to motors for their operation according to user commands.

The Commands we provided are

GO FORWARD

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GO BACKWARD

LEFT

RIGHT

STOP

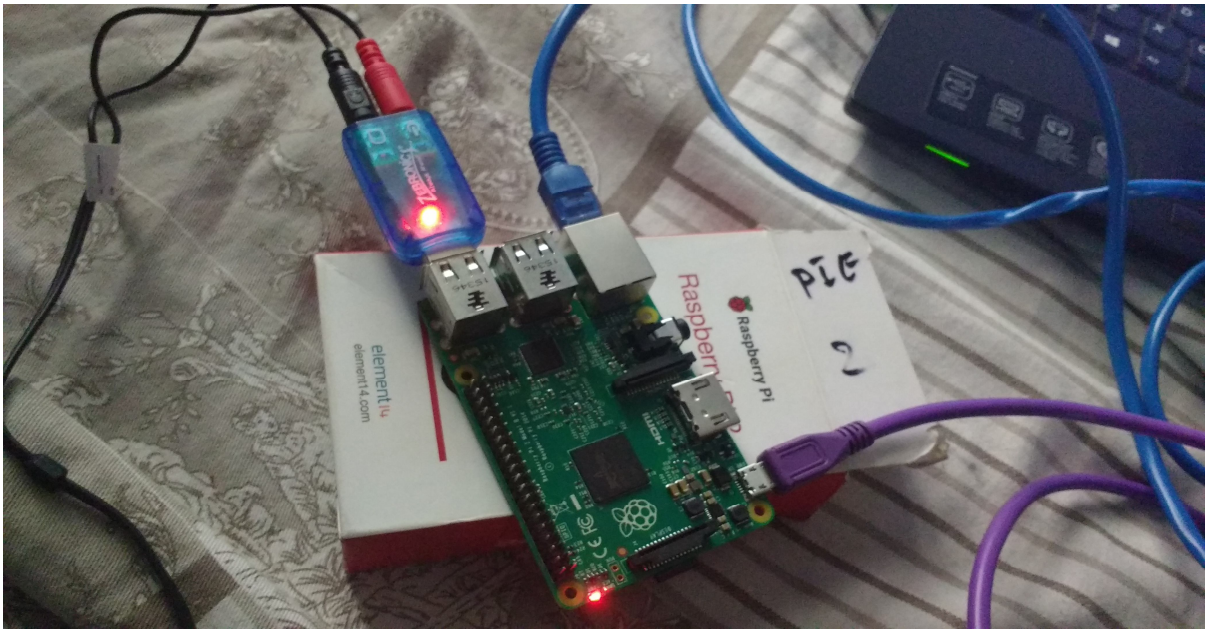


Fig 4.2 voice recognizer unit on Raspberry pi 2 model B

B. Motor Driver Circuit H-Bridge

1) Features: 1. L293d circuit can handle 2 motors at a time.

2. It uses 9v battery for spinning motors in both ways.

The motors Driver gets input from the Speech recognizer based on user commands by the shell script to turn on /off GPIO pins for input on Motor Driver. The Enable pins on the L293d should be on for a motor to run

Then the input combinations for the output are as follows

Input 1	**Input 2**	**Direction**
True	False	forward
False	true	reverse

Fig 4.3 Truth table for motor directions.

The motor driver circuit has 600 mA and 1.2 peak voltage.

IV. EXPERIMENTATION RESULTS

The voice recognizer circuit has an average efficiency of detecting 85% of words for males and 93% of words for females. Thus we calculated efficiency for several words on 51 speakers (25 male, 26 female) and the experimentation results are as follows in Fig 5.1

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Word	Male	Female
Forward	89%	92%
Reverse	92%	94%
Right	95%	96%
Pi	74%	78%
Stop	81%	83%
Julius	88%	90%
Read	85%	89%

A. Experimentation Inferences

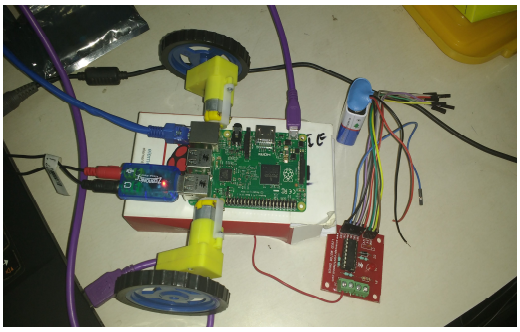


Fig 5.2 Voice Recognizer with Motor Driver

V. FUTURE WORKS

The utilities such as embedded phonebook with the Vehicle and the Navigation with voice control can be the future enhancements.

VI. CONCLUSION

Our system may provide an efficient design of voice controlled vehicle and can be used with voice controlled robots thus usage of Google API lightens the intensity of payload on processor.

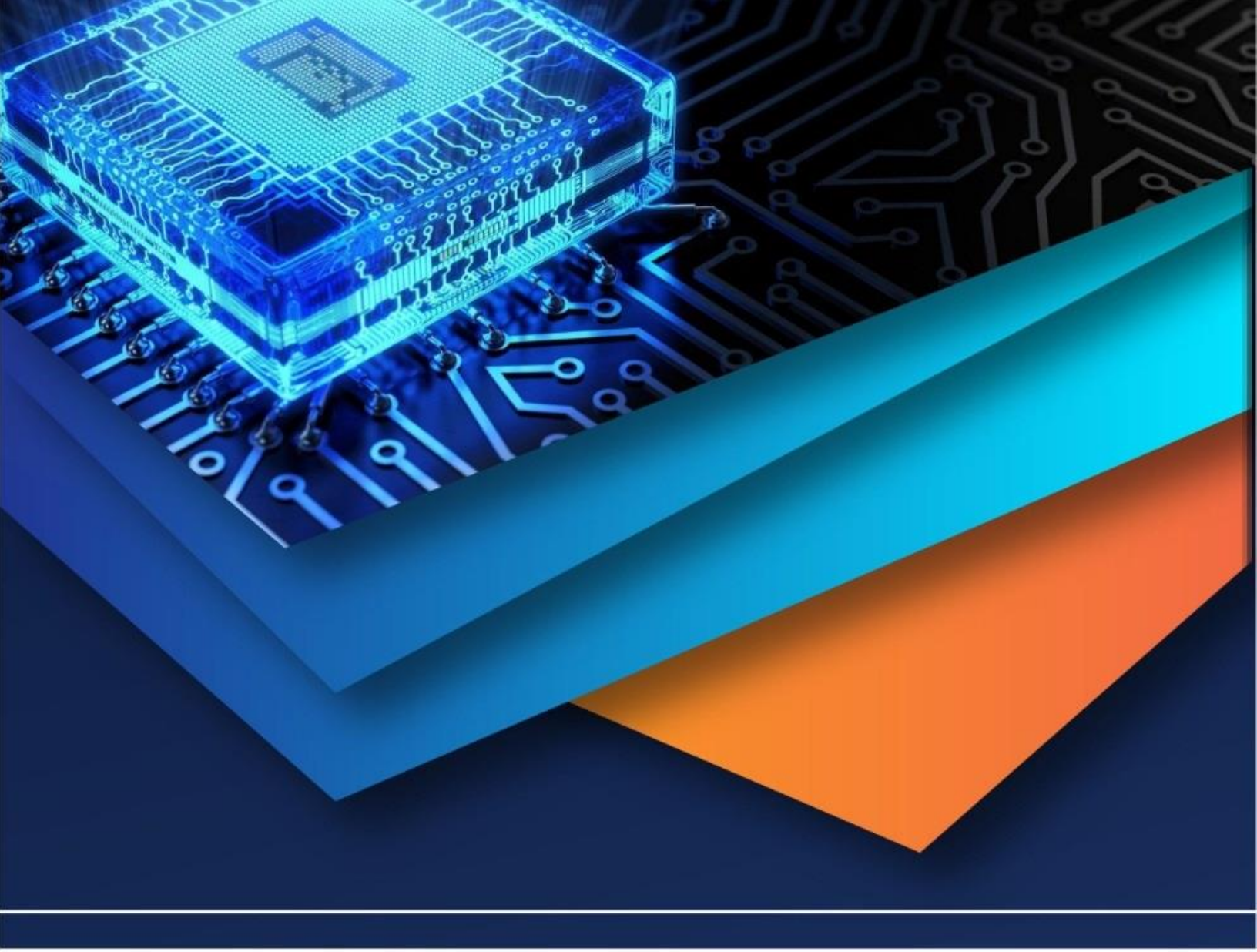
VII. ACKNOWLEDGMENT

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