In-Car Speech Recognition using Alexa

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Abstract— This technology enables the features of Alexa Echo in the car which will help the driver to enjoy his journey. The technology will also help to solve the complexity of car control. Now the world using the IoT on a mass scale. During the 2020 experts estimate 31 billion IoT devices will be installed. With the help of a voice recognition system, we can control the functions of a car with just a voice.

Keywords: In-Car Speech Recognition using Alexa

I. INTRODUCTION

The project is about a speech recognition system for the vehicle. This is used to perform some actions using speech commands by the driver or the passengers. The main intention behind implementing this is to simplify the life of the driver and passenger in a vehicle. Also, to avoid accidents.

It will be a user-friendly system used to control some basic and secondary functions of the vehicle such as open/close doors, switch on/off the headlamp, and signal indicator of the vehicle. Basic comfort functions consist of optional equipment of a car related to driving comfort, e.g. air conditioning or radio. They are usually easily accessible but not always intuitively to operate. As before, the reaction time is instant. Malfunctioning is not significantly influencing car usability.

II. LITERATURE REVIEW

In [1] Ivanecky J., Mehlhase S said that during the Speech Recognition process, the original speech will be distorted by the environment noise and distortion. Due to which the system may not able to capture the original signal produced by the user. Therefore, no output will be generated. An improved model of masking effects for a robust speech recognition system explained that the performance of an automatic speech recognition system will drop dramatically in the presence of background noise, unlike the human auditory system which is more adapted at noisy speech recognition. In order to solve the problem, and auditory modeling algorithm is integrated into the feature extraction front-end for the Hidden Markov Model (HMM) which is named later as LTFC to simulate the properties of the human auditory system and be used in speech recognition system to enhance its robustness. The proposed method sharpens the power spectrum of the signal in frequency and time domain.

In one more study report [2], Kepuska, Veton, and Gamal Bohouta said that Artificial intelligence (AI) can dialogue between humans and machines. In recent years, the dialogue systems, also known as interactive conversational systems are the fastest growing area in AI. Many software companies have used Dialogue systems technology. Such as Microsoft's Cortana, Apple's Siri, Amazon Alexa, Google Assistant. A similar project is used for house automation. The latest car has many functions but it needs to control manually. There is a lack of comfort. We have overcome these problems by implementing the project.

In [3], Jozef Ivaneck´y, described efforts towards a hybrid speech recognition system to control secondary functions in the car. The hybrid speech recognition system contains a fast, grammar-based, embedded recognizer and a remote, server-based, LM-based, large vocabulary ASR system. Their main focus was on maximizing the reliability of the embedded recognizer and designing an algorithm for switching and the server-based ASR system. They evaluated the system into two major aspects. The first aspect is to examine the speech recognition accuracy for different grammars and noise levels. The second aspect is evaluating the switching between the local and the remote recognizer. They analyzed the usage options for disabled drivers and identified possible risks that need to be minimized.

III. IMPLEMENTATION

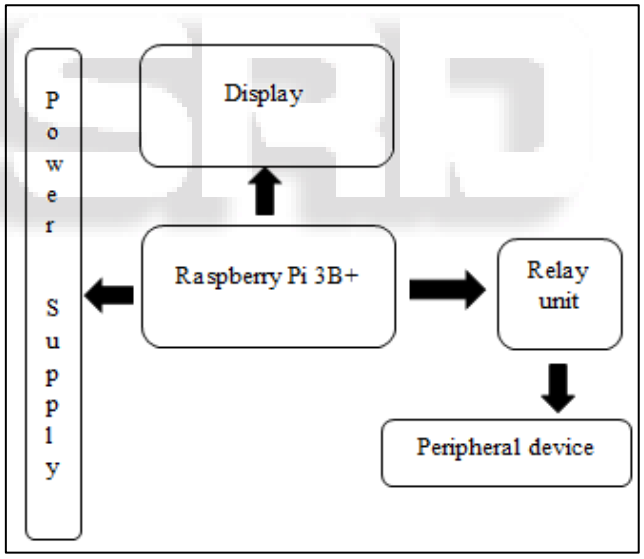

Fig. 1: Block diagram

A. *Block diagram:*

1) Raspberry pi 3B+: - It consists of a Broadcom chip. It also has built-in WIFI and Bluetooth for connectivity. We use the Raspbian stretch OS.
2) Display: - The resolution of 1024*600 or 800*400
   It is a single touch screen display. The HDMI is provided for video single transfer. And MIRO-USB for power and touch detection.
3) Relay unit: - It is used to turn on a car peripheral device. We separately design the relay unit for our purpose. We can bypass the car relay unit and control the car peripherals.

B. Algorithm:

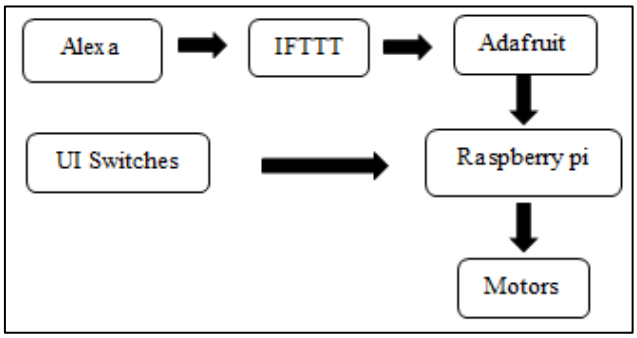

Fig. 2: Algorithm of system

With the help of Alexa voice service [4], we can give the command to it. The Alexa voice services are integrated with IFTTT. Further, the IFTTT recognizes the command and trigger the event. The trigger will change the parameter value on the Adafruit server. As show in Fig. b.

The main control unit that is raspberry pi read the value from the Adafruit server. As the value changes the respective action will execute raspberry pi. It gives a signal to the switching circuit and the peripheral is operated.

Another way to control the peripheral is by UI Switches its nothing but Local web page GUI it. The user can interact with the GUI with the help of the Display which is provided. The GUI shows the peripheral switches with their current status. The current status is also updated to the Adafruit server.

We will better understand if we consider one of the examples. Let's take the example of a window. For that, we have to say command as follows "Alexa opens the window of front passenger window". Now IFTTT will take charge and change the value of the front passenger window to 1 on the server. The value on the Adafruit server read by raspberry pi gives a signal to the ECU unit. Now the front passenger window will be open. Now the same task will be done with local web-based GUI. We just have to turn on the switch of the front passage window. The raspberry pi will give a signal to ECU. Also, update the status. On the Adafruit server.

C. Alexa Smart Screen SDK

The Alexa Smart Screen SDK[5] extends the AVS Device SDK to support development for screen-based Alexa Built-in products. The Smart Screen SDK enables device makers to build screen-based products that complement Alexa voice responses with rich visual experiences. The SDK for Alexa Voice Service, which implements Alexa intelligent voice control functionality.

The SDK's is a JavaScript-based GUI client app. It's a sample app. The App consists of below interfaces.

GUIManager – It is the interface between the capability agents and the GUI.

GUIClient – It is the interface that manages messages from GUI to the sample app.

APLCoreTextMeasurement— The interface that handles text measurement requests from the APL Core Library.

APLCoreGUIRenderer— The interface that handles the creation of APL documents.

WebSocket server— The reference implementation of a WebSocket-based messaging interface.

With the help of SDK's virtual task such as showing the weather or showing information about music is shown. Another example is we can play videos. The SDK is complete the need for medium requires interface with us.

Alexa is a voice-controlled virtual assistant. She can play audio, control your smart home, answer questions, and engage your favorite services to keep you organized, informed, safe, connected, and entertained. As a product of Amazon, she's also your shopper.

Alexa is like the software that powers your smartphone, but instead of apps, she uses "skills." Like your smartphone, Alexa includes many skills out-of-the-box, while others can be enabled by choice.

Alexa's features which make our system smart are listed below:

1) Play music
2) Report the news
3) Check the weather
4) Control car's peripheral
5) Cell phones and other Alexa-enabled devices

Some other features Alexa can do are further listed below:

1) Manage your lists and calendars
2) Set timers and alarms
3) Find local business information
4) Answer questions
5) Find recipes
6) Teach history lessons
7) Shop on Amazon

IV. RESULT

Sr no.	Operations	Completed test cases	Total cases	Efficiency
1	Turn on headlamps	8	10	80 %
2	Turn on vapors	9	10	90 %
3	Power windows	8	10	80 %
4	Turn on the Air conditioner	7	10	70 %
5	Total	32	40	80 %

Table 1: observations

V. DISCUSS

A. Electronic control unit (ECU)

This is the most curial piece of equipment which has control over the car. ECU is an embedded system which is capable of controlling most of the car peripheral like unlock the door, opening window

We can interact with a car with the help of display which is driven by ECU. ECU has the following types.

1) Door control unit (DCU)
2) Engine control unit (ECU),
3) Electric Power Steering Control Unit (PSCU)
4) Human-machine interface (HMI)
5) Powertrain control module (PCM)
6) Seat Control Unit,

7) Speed Control Unit (SCU),
8) Telematic control unit (TCU),
9) Transmission control unit (TCU)
10) Brake Control Module (BCM; ABS or ESC)
11) Battery management system (BMS)

B. IFTTT

IFTTT [6] is an online platform that helps to connect the things or the app that we use on our daily basis. It stated On December 14, 2010. The platform now offers the 600 plus app and its various functionality. The popular music app such as Spotify, Apple music. We can control our mobile. Such as making it silent when we reach a specific location or according to time. We can integrate the popular al languages such as google assistance and Alexa [7]. We perform certain tasks such as making a grocery list. They have their app for android and iOS users. It also consists of analytics. As discussed earlier it connects different app and creates triggers. For example, when the delivery guy reaches the door it automatically turns on lights of the hall of giving us notification.

C. Adafruit

Adafruit.io [8] is a cloud service that consists of a dashboard and feeds. Which is the key element we can change the value of the feeds like variable? The dashboard is collects and representation of feeds. It can also represent the feed in terms of a graph. It also shows real-time data. It stores the history of feeds so we can understand how much changes happen and also with time and date. We can integrate it with other services such as IFTTT.

The feeds can be a switch, slider, button, gauge, etc. it also has the ability of location services. For security, it has a unique API (application program interface). The same API that drives the user interface is available to them. They also provide documentation so the user can build a library. The data can download from anywhere and anytime. Charts, graphs, gauges, logging, and more are available in their dashboard. The triggering service is also provided it will post the notification on the user phone. They can contact with user for notification. The call is computer generated. They also have a community to help the newcomer to guide and solve the problem related to the platform.

VI. CONCLUSION

Based on the preliminary result obtained from the speech recognition system using Alexa in a car, the efficiency is approximately 80%. The system is designed to overcome the manual handling of the peripheral in the car such as windows, viper, headlight, etc. by use of assistance like Alexa. The system makes the user comfortable so that the user will not distract too much. To improve the performance of the system, some improvement such as multiple languages and commands will be added in the future to improve the overall performance of the system. To achieve have better performance and efficiency due to current limitations. Moreover, the system can be used in home automation or in another field where software assistant required by upgrading.

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