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Speech Enabled Home Automation and Motor Control Using Raspberry Pi

G. Pavangopal[1], D. Yugandhar[2], B. SaiKrishna[3], B. Gowtham[4], Mr. M. PardhaSaradhi[5]

[1,2,3,4] *Student, Dept. of ECE, VVIT, ANDHRA PRADESH, INDIA*
[5] *Associate Professor, Dept. of ECE, VVIT, ANDHRA PRADESH, INDIA*

Abstract - *The Internet of things (IOT) is simply monitoring and controlling of physical devices, vehicles which are embedded with sensors, software, electronics and network connectivity to exchange data. This includes home automation, controlling robots etc. Because of its many advantages, home automation is becoming popular day by day. Home automation is done by emails, texts and other applications till now, but our project manages the work by user's speech commands. This working model includes Raspberry pi development board, microphone, relay board, motor driver board and a NodeMCU. It aims to provide a speech control interface for home automation and the robot. Same way the line following robot can be controlled by using user's speech commands. It is mainly helpful for the elderly and disabled persons for the quick completion of work in less time.*

Keywords: Home automation, Raspberry pi, NodeMCU, Speech commands, Motor driver board, Robot.

1.Introduction

It is a proud moment to the whole world for having day to day developing technology. The foremost aim of the technology is to increase the efficiency and to decrease the effort. In this trending world, Internet of Things is being given extreme importance. Automation in that specific path that leads to have less effort and much efficiency. By using IoT we are successful in controlling various areas. In which one of them is to control the home automation by using raspberry pi. We can also use other boards like beagle bone. In the present-day technology, the whole work is done through communication. We have considered that the effective way of communication can be done through voice. Even though the technology is developing in our day to day life, there is no help coming into existence for the people who are physically not good on the basis of technology. As the 'speech enabled home automation system' deploys the use of voice to control the devices, it mainly targets to the physically disabled and elderly persons. The home automation will not work if the speech recognition is poor. The speech which we give will be given as input by the *Microphone.* Microphone recognizes the speech given by the person and sends it to the recognizing module. It searches for the nearest word even if there are any disturbances in it. If the command (ON/OFF) is given, the action is done. Similarly, the line following robot functions with respect to the speech commands given to it. The line following robot moves forward and backward with the help of sensors and a motor driver board.

1.1. Literature Review

One of the existing methods regarding the speech recognition using wireless home automation is done through ZigBee communication module. To have a brief note on this, this model includes the following components i.e., Home Automation, ZigBee transceivers, voice recognition, analog to digital converters and differential pulse code modulation. This home automation point outs the recognition of voice commands and it uses low power RF ZigBee wireless communication modules. Even this system controls the electric lights and other appliances. The system is initially to be checked i.e., regarding the voice recognition test, handheld microphone module, ZigBee communication test and the Differential Pulse Code Modulation for managing the compression and decompression of speech signals. Initially, the voice is recognized with some frequency of sampling rate. An anti-aliasing filter is used to block the frequencies above the Nyquist rate. The recognized voice is digitalized using ADC and it sends the data serially to the central microcontroller. It now passes the data into the computer after converting the digitalized data in analogue form. Now the data is analyzed and the string commands are sent serially to the microcontroller. These commands are finally used to control the appliances wirelessly. The other way in handling the speech enabled home automation was through an Android and an Arduino. The system is designed in such a way that, it should be flexible to any residence structure. It means the user can flexibly be able to control the devices without the help of the second person i.e., technician. The total need of the system is done in an android mobile application. That should communicate with an Arduino board in local network. It should be tested in a miniatured residence during the real case scenario. The few disadvantages are recognizing the voice properly. Also, it does not give any response regarding the function going on. Our project aims to overcome these disadvantages by using Raspberry Pi and a Node MCU.

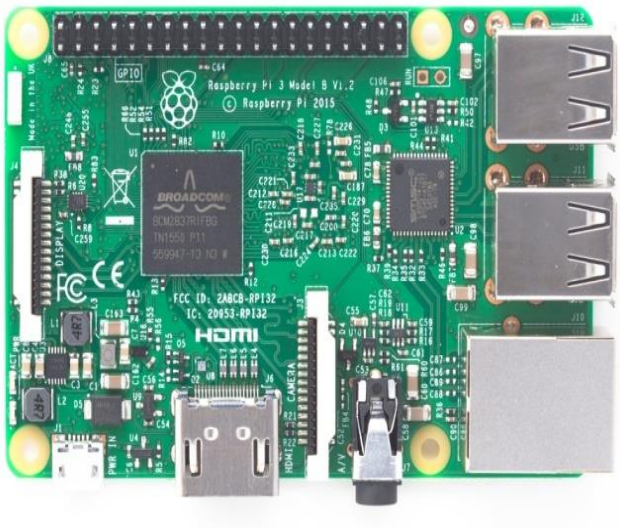
2. System Overview

Hardware Used:

a) Raspberry Pi:

Raspberry pi is a series of small, credit-card sized computers of low cost developed for computer education in UK. PI is available on various versions. Here the Raspberry Pi-3 model B uses a Broadcom BCM2837 system-on-chip (SoC). The

speed of the processor ranges from 0.7GHz to 1.2 GHz and it varies in other series of Pi. The operating system is stored on Secure Digital (SD) card. The Board contains four USB 2.0 ports for effective operation. HDMI is used for video output with basic 3.5mm audio jack. It has 40 GPIO pins to control things on run time. It has quad core ARM Cortex-A53 CPU and supports networking through Ethernet, 802.11n on-board Wi-Fi and Bluetooth.

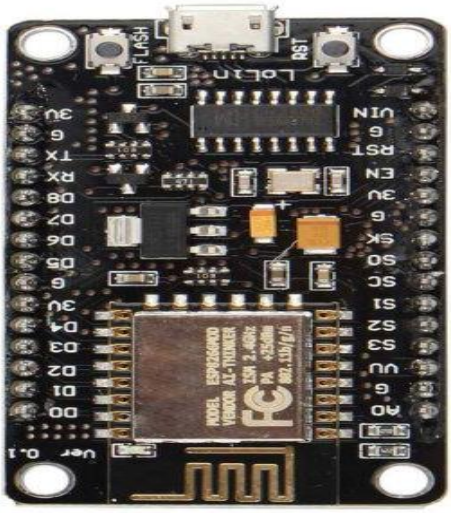


b) USB Microphone:

It is used for converting speech input to the electrical output. Here the USB 2.0 microphone is used as an intermediate between the user and pi. The USB 2.0 has a high signaling rate of 480Mbit/s but due to bus access constraints it is limited to 280 Mbit/s to 335Mbit/s.

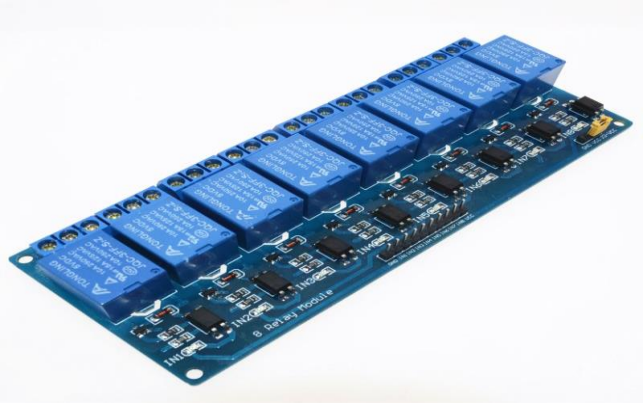
c) Node MCU:

Node MCU is also known as Node Microcontroller Unit. It is an open source software and hardware development board. It is equipped with ESP8266 System-on-Chip (SoC). It includes firmware which runs on ESP8266 SoC. These are available in different versions. Here the V2 and V3 versions of them are used. These are equipped with a micro USB port for power supply and program debugging. It consists of GPIO, SPI, UART, ADC and power pins. It has a memory of 128 Kbytes with ESP8266 CPU. It is used for wireless connection to home appliances and motors.



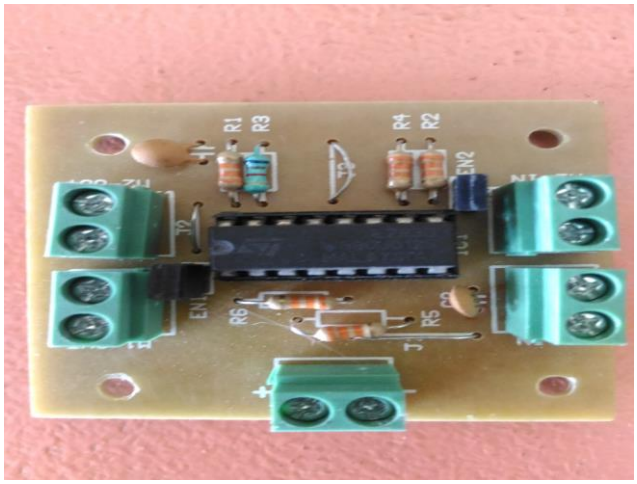
d) 8 Channel Relay Board:

Relay is switch which can be operated electrically. This is used to control various appliances with large +current and voltage ranges. These can be controlled directly by a Micro-controller. The numbers of channels represent number of appliances that can control.



e) L293D Motor driver:

It is simple motor driver IC which allows DC motor to rotate on both directions. It is a 16 pin IC. The supply voltage is 9-12V.



f) DC Motors:

It is a class of rotator object which converts electrical energy to mechanical energy. It works on the electromechanical principal.

SOFTWARE USED:

a) Amazon Alexa:

It is a personal assistant developed Amazon which is capable of interacting with the user. It is a cloud-based voice service. It takes the commands from user by speech and responds through audio with appropriate solution to it. The speech commands are processed by Alexa Voice Service (AVS). Here we use Alexa to have our speech inputs and further for completion of work.

b) Arduino:

Arduino is open source software to program microcontroller kits for building digital devices that can sense and control objects in real time. A typical program of Arduino consists of two functions namely setup () and loop (). The names of the functions itself defines the function.

i. **setup ():**

This function is executed once, that is after reset or power-up. It is used for variables initializing and input and output declarations.

ii. **loop ():**

This function is executed after the setup function. It continues execution until the board is powered off.

c) IFTTT:

It is abbreviated as If This Then That. It is a free web-based service for linking other web services by conditional statements. Here it links Amazon Alexa with Adafruit IO.

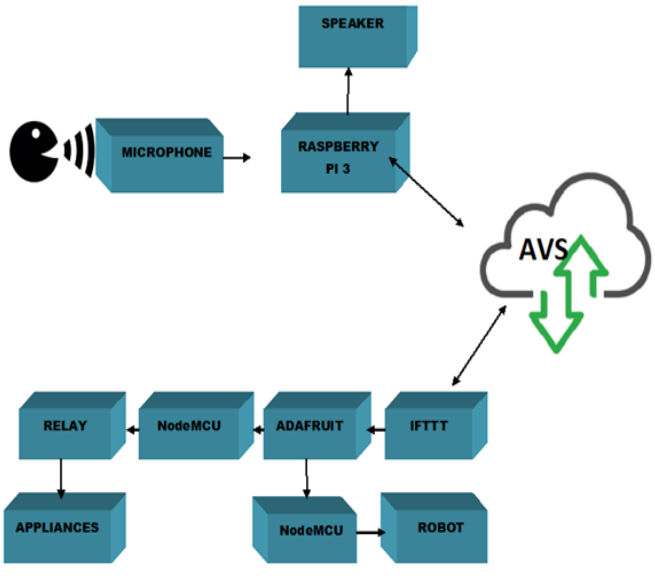
d) Adafruit IO:

It is a MQTT API (application program interface) that allows connecting things over internet. It's simple and connecting takes about 80 bytes for connection and 20 bytes for data subscription. It can be run on any type of network.

2.2. Proposed Work

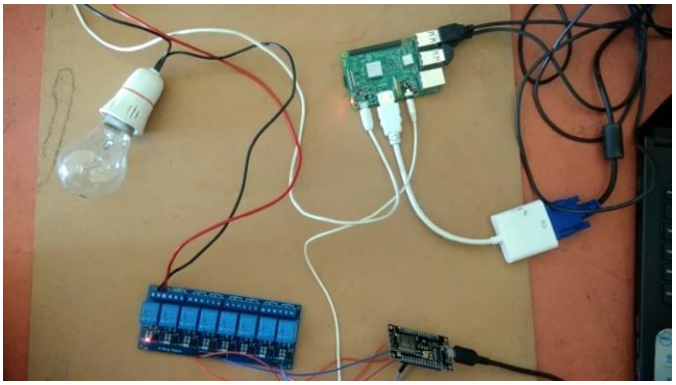
As we are using the Raspberry Pi 3, we have to make sure that it is installed with Raspbian operating system (Raspbian Jessie). We need to create an Amazon developer account to access the Alexa voice service. The Raspberry Pi 3 is serially connected to the monitor. The speech we give is to be converted in digital form using an USB Microphone which is also connected to the Raspberry Pi 3. The Microphone recognizes the speech which we give and sends it to the Raspberry Pi board. The Raspberry Pi sends the data to the cloud (Alexa voice services) through the WIFI module. The required information will be sent to the NodeMCU through a platform called Adafruit. To connect this Adafruit to Alexa voice service, we have a web-based service called IFTTT. As we are familiar with the abbreviation, THIS indicates Alexa voice services, THAT indicates Adafruit. An account is to be created in both IFTTT and Adafruit. The IFTTT account is to be connected in the Adafruit. The NodeMCU is connected to Adafruit using the key AIO which is generated in the Adafruit account. The requested output is generated at the NodeMCU. The NodeMCU is connected to the relay board and the relay board switches to the requested output i.e., appliances. The same process is continued until the functioning of NodeMCU for the line following robot. The NodeMCU is connected to the Motor driver board (L293D) as well as the IR sensors with the help of GPIO and VCC pins in the NodeMCU. The IC L293D is connected to the battery and the motor. The motor functions using sensors with respect to the commands from the Node MCU.

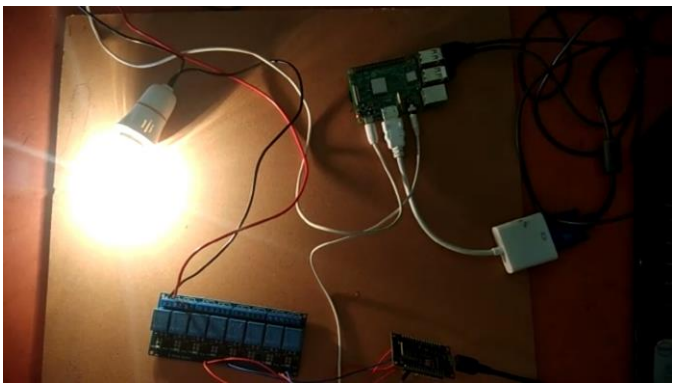
2.3 Design flow:



OUTPUT:

https://www.youtube.com/watch?v=AFyJHMEAE78





3. Conclusion

Thus, the Node MCU is successfully interfaced with the Raspberry Pi 3 and the wireless communication is achieved. Finally, using this project we were successful in reducing the effort and is helpful for the elderly and disabled persons.

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