

Personal Assistant Based Home Automation using Raspberry PI



Neha Ganesh Deshpande, Devendra A. Itole

Abstract: A desired technology in 21st century for home automation is an intelligent system. An objective of any automated system is to reduce human labor, efforts, time and errors. Commonly Home Automation is a system where various home appliances like air conditioner, TV, Refrigerator, etc are capable to communicate with each other and they can be remotely controlled. Here is presented a paper which discuss a home automation system through virtual personal assistant's capability of speech recognition and through raspberry pi to automate home devices such as air cooler, lights, fans, TV etc. This system is a combination of various different technologies such as voice recognition, voice analysis and voice processing. A device microphone is used to receive voice requests while the speaker gives voice output. The system also uses Artificial intelligence techniques which can solve various human queries through web search and can also control the home appliances.

Keywords: Personal Assistant, Home Automation, Raspberry Pi, Google Assistant, Artificial Intelligence.

I. INTRODUCTION

Home automation has undergone a large scale development. Everything from lights, fans can be controlled through central panel or through wireless devices using an application or voice commands. Home automation makes elderly or differently abled independent and self-reliant to some extent.

It varies from basic switch controlling to creating different home environments in house based on requirements like calling a person, controlling the HVAC systems, etc. and many other advancement functions in the technological aspects.

The currently market leading technologies in Home Automation are Google Home, Amazon Alexa, Apple HomeKit. All these technologies are only control hubs. Home automation compliant appliances are required to be purchased for functioning. Examples of such appliances are Avion, Canary, Philips Hue, Google Cast, Senti and Nest Thermostat.

The research till now depends on such devices. Some have built their own network which is cost effective. Controllers like microcontroller, Aurdino, Raspberry pi have been used.

The hardware part of this personal assistant system uses Raspberry pi and relay module while software part of the system uses raspbian operating system.

II. LITERATURE REVIEW

Many works have been carried out in home automation system.

In 2015, D. Celebre, A. Medina, D. Dubouzet, M. Surposa, C. Gustilo focused on implementation home automation system through siri's capability of speech recognition and through Raspberry Pi as a low cost control system to automate home appliances. They used 8-channel relay module and L298N motor driver. They configured the Raspberry Pi's network and DNS settings, using raspbian operating system in order to connect to siri enabled mobile devices. This system automated five appliances inside the room. The overall success rate of this system was 93.333% with 2.12s latency [1].

In 2018, Harsh Vardhan Bhatnagar, Praveen Kumar, Seema Rawat, Tanupriya Choudhary implemented a model of wifi based smart home. The function of this system was carried out by an android application or Google assistant. The communication with firebase database was achieved through android application and in turn it enabled to electrical appliances and various sensors. The model uses Node MCU ESP 8266 I2E as a controller and sensors like MQ 6, MQ 135, DTH 11 etc [2].

In 2017, Dr. V. Chayapathy, Dr. Anitha, G S, Sharath B implemented a system that uses a personal assistant which helps users to interact with home appliances using gesture and speech commands. The system uses Google's speech recognition application(API) to convert speech into text [3].

In 2016, Md. Al-Amin and Syeda Zinath Aman, designed a Raspberry Pi based intelligent system which controls the home appliances using internet. They used remote control system via world wide web to control home appliances using four modules such as speech recognition module, power control module, remote control module and core control module [4].

In 2017, Vikram N, Harish K. S, Nihaal M. S, Raksha Umesh, Ashok Kumar, implemented a low cost Home Automation System using wireless fidelity. In this system, for monitoring and controlling environmental safety and electrical parameters of interconnected home a wifi based wireless sensor network is designed [5].

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In 2018, Veton Kepuska and Gamal Bohouta implemented the structure of Next Generation of virtual personal assistants. They have used graphics, speech, gestures, videos and other models for communication in input and output channels [6].

In 2015, Kumar Mandula, Ramu Parupalli, CH.A.S. Murthy, Rutul Lunagariya proposed a prototype of home automation using Bluetooth and Ethernet for indoor and outdoor environment respectively. They have used microcontroller based Aurdino board and an Android mobile phone for controlling the home appliances [7].

In 2017, Bhaumik Vaidya, Ankit Patel, Anand Panchal, Rangat Mehta, Krish Mehta, Parth Vaghasiya, proposed a smart home automation system for old age people. The system is based on python, OpenCV, raspberry pi and android application. In this system according to the user commands received from the mobile phone, the appliances are controlled through the raspberry pi server. Also, face recognition system is used for the purpose of unique door monitoring [8].

In 2018, Jaun Celis, Rodrillo Llanos, Sergio Castro, Sergio Sepulveda, Byron Medina, Dinael Guevara, Luis Camargo, Jorge Gomez proposed a system which presents a acoustic and language model to execute, control and supervise activities through voice processing. They have used Raspberry pi, Arduino, different sensors and relay module to control the lights. They used Python as a programming language for communication between voice processing and home automation system [9].

From the above review we have included the idea of home automation using a Google assistant, and we have found that the Raspberry Pi as a user friendly processor.

III. SYSTEM DESIGN

The Personal Assistant based home automation system consists of Raspberyy Pi and 8-channel relay module. The architecture of the proposed system is shown below:

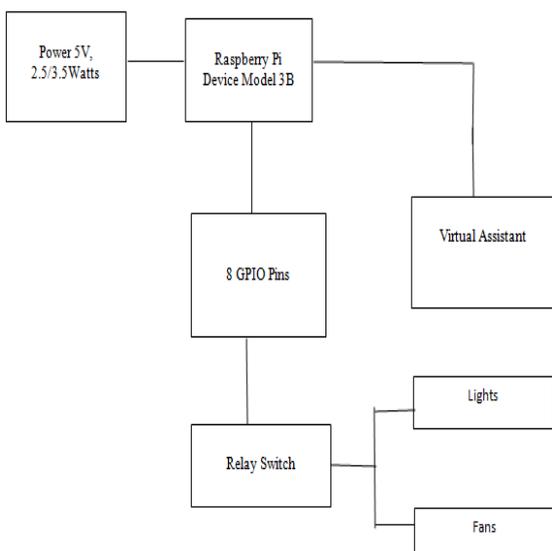


Fig. 1. Block Diagram of the system.

Fig.1. shows how the system at home will be automated. The block diagram includes Raspberry Pi as the main controlling unit or a processor, and a relay module to connect the appliances which are to be controlled through the Google Assistant.

The system design is a combination of several phases such as data collection in the speech form, analysis of voice and conversion into text, storing and processing data, and controlling lights through Google assistant.

The input is taken in the form of voice through a microphone connected to the Raspberry Pi. When user asks a Google Assistant to answer any queries or perform any task, the audio signal is converted into digital signal which can be analyzed by software. Then there is a comparison between this input data and database, which is located on the cloud network using an innovative algorithm to find a suitable answer.

For switching the lights as per the user needs, relay module is connected to the Raspberry Pi through GPIO pins. The role of relay is switching. When user gives a command to switch on the light, the corresponding pin will automatically turn ON.

The System flow is as shown below:

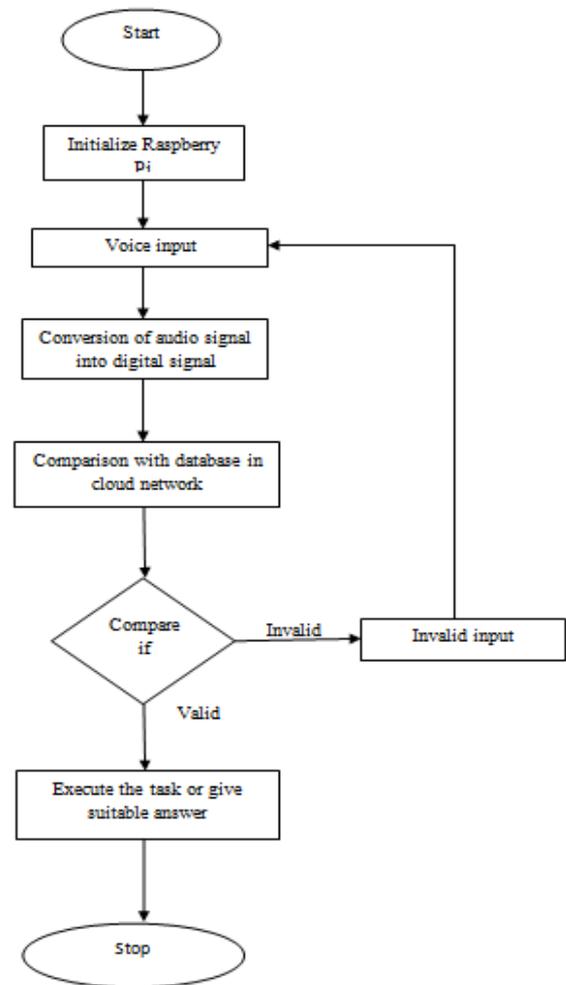


Fig. 2. System Flow.

The controlling appliance at the user end would be a Google assistant which is implemented on a Raspberry Pi. Google assistant will answer the queries of a user as well as it will perform a task of controlling home appliances.

IV. HARDWARE DESCRIPTION

In this section, we describe the hardware part of the home automation system. The hardware part of the system consists of Raspberry Pi 3B model and 8-channel relay module.

A. Raspberry Pi

The Raspberry Pi is the low cost and small size computer that can be plugged into a computer monitor or TV. It uses mouse and a standard keyboard. Raspberry Pi has in-built common ports like any computer or laptop such as audio and video out, HDMI port for display, Bluetooth, RJ-45 LAN port, two USB ports. We have chosen Raspberry Pi as a processing unit for this system because of its user friendly features.



Fig. 3. Raspberry Pi 3B model.

B. 8-Channel Relay Module

The appliance in this study is connected to Raspberry Pi through an 8-channel relay module. This appliance is light. Relay is a medium to connect appliances to the Raspberry Pi



Fig. 4. Relay module.

V. SOFTWARE DESCRIPTION

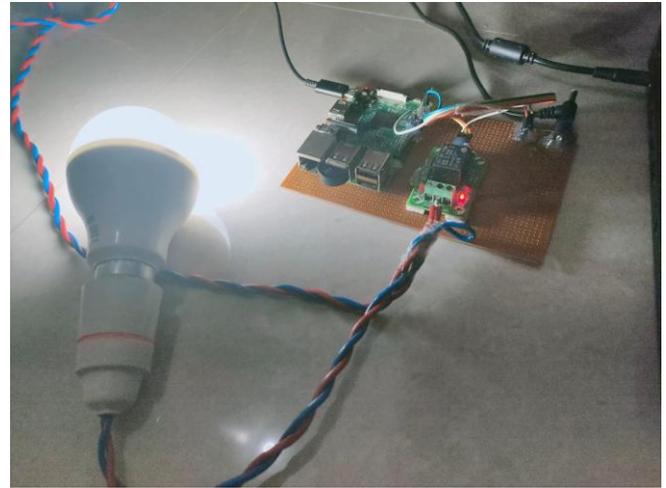
The software design of the system mainly involves translation of voice commands into text, for main control system to recognize the command which enables a device.

Software design of this system mainly includes setup of hardware and network access, configuring and testing audio,

configuration of a developer project and account settings, registering the device model, installing the SDK and sample code and running the sample code.

VI. RESULTS

The proposed system is tested and the result is shown in fig below.



For triggering this Google Assistant, the command “Ok Google” is used. When the user says “Ok Google”, this Google Assistant will be activated and it starts listening to the further commands. For example, when it is asked about Weather, current time, location, cricket score, mathematical problems, or any general information, it quickly responds to the questions. Also, when it is asked to turn ON or turn OFF the LED, it acts as per the instruction given to it. When the instruction is given, the Google assistant will go to the Google cloud server and then it will go to the Raspberry Pi. Then, Raspberry Pi will enable or disable the corresponding GPIO pin to control the LED.

VII. CONCLUSION

Thus, we conclude the work for the home automation system through Google assistant is to minimize the human efforts. This paper represents the hardware implementation of real time personal assistant based home automation using Raspberry Pi. The home automation system was successfully implemented using Raspberry Pi, which automates the appliance through Google Assistant’s capability of speech recognition. The system successfully turns LED on and off. Hence, using this system we can automate different appliances to reduce human efforts, time and errors.

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Devendra A. Itole has completed his PG degree in Electronics and Telecommunication. He has BE completed in Electronics and Telecommunication. .He is currently pursuing PhD. He has teaching experience of 10 years and also industry experience of 1 year. He has published more than 10 papers in journals.