Smart Home Automation Using Rasberry Assistant

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ABSTRACT

The world is fast moving towards AI and one of the most basic versions of AI is the smart voice assistant devices. Voice assistant reduces the human body movement for carrying out a physical task thereby increasing the productivity and saving time. Some of the smart devices takes decision based on how the algorithm is trained to carry out a task, this helps in saving a lot of resource and money. Home automation is building automation for a home, called a smart home. Smart home technology which may also be termed Home automation is the use of devices in the home that connect via a network, most commonly a local LAN or the internet. The Raspberry Pi is a low-cost credit-card sized single-board computer. A low cost computing environment using Raspberry Pi based systems is very efficient to use as a proposed computing systems. Technology is intended to make one's life more comfortable and carry out tasks at ease. Hence voice assistant systems such as Smart Home Automation are designed to work on these aspects of requirements.

Keywords : Rasberry Pi, MQTT Protocol, nodeMCU, STT library

I. INTRODUCTION

Home Automation is building automation for a home, called a smart home. A home automation system typically connects controlled devices to a central hub or "gateway". Smart home technology which may also be termed Home automation is the use of devices in the home that connect via a network, most commonly a local LAN or the internet. It uses devices such as sensors and other appliances connected to the Internet of Things(IoT) that can be remotely monitored, controlled or accessed and provide services that respond to the perceived needs of the users. It stands for self-Monitoring Analysis and Reporting Technology.

The Raspberry Pi is a series of small single-board computers. The Raspberry Pi is a low-cost credit-card sized single-board computer. The Raspberry Pi uses the ARM processor architecture, which is also used by most modern mobile phones. The Raspberry Pi is a utilitarian single-board computer (SBC) designed for a bevy of applications. With its small footprint and low power draw combined with beefy processing capabilities for its size, the Raspberry Pi is well-suited as an always-on device.

A voice command System essentially means a system that processes voice as an input, decodes or understands the meaning of that input processes it and generates an appropriate voice output. Any voice command system need three basic components which are speech to text converter, query processor and a text process sound and voices than to process written text, hence voice command systems are omnipresent in computer devices. There have been some very good innovations in the field of speech recognition.

One of the most important parts of such an assistant is represented by speech recognition also called speech to text translation because it transforms human voice into a string of data that can be interpreted by the computer. However, in recent years cloud-based speech recognition systems have been developed a lot. In this way, all elements of a voice controlled assistant are placed in cloud. The most important ones from this category of assistants are Apple Siri, Google Assistant and Amazon Alexa. They are present in most smart-phones and are based on artificial intelligence elements such as deep learning and neural networks. Apart from voice digital assistants, other systems that have been developed using this idea are call centers, systems for self management.

To design and develop a market ready prototype of voice assisted home automation system that is customizable, cost effective and privacy protected. The commercial ones like Alexa are a bit costly and is not customizable according to the customers need. So, the objective is building a cost-effective system without compromising on the quality of output. Privacy issues comes into picture up when your devices are connected to the cloud and internet. Hence our system will be privacy protected. These are the solutions that we are coming up in the current system:

- Privacy – The voice assistant API or STT service provider in the current system needs an active internet connection and the data goes over the cloud. In order to address the privacy, issue the system is designed on an offline STT service provider.
- Customisation – In order to make the system customisable, it is designed on an open source platform which also makes it a cost-effective solution.
- Easy to integrate – A good design is one which can be easily integrated to an existing system. Hence the master and slave modules are connected over Wi-Fi network and not connecting wires/cables

which prevents disturbing the existing wiring plans.

II. LITERATURE SURVEY

A. Overview of Smart Home Automation

Smart home automation has attracted the interest of the research community during the last decade, at a great manner. Home security systems consist a constantly developing research field. In this paper, a security system for smart home automation is proposed. The introduced system operation is supported by a GSM embedded mobile module, which enables the alert messages transmission to both mobile devices of end users, and central security offices. The proposed system is implemented on a microcontroller module, through an embedded platform. The proposed system operates on different levels of user's access control, based on passwords policies. Each time, the involved end users and the security offices, can be informed for operation modes change through SMS communication, via the available GSM network. The proposed system design is based on a microcontroller device, embedded in an Arduino system module. However, a system like that can be based on a large variety of other available microcontrollers, if the developer makes the appropriate changes. Arduino is an open-source electronic, prototyping, computing platform used for system development. It can be used to develop both stand-alone interactive objects, or can operate efficiently with software co-design, supported by another computing system. It consists of a physical programmable circuit board and parts of software coding. The circuit board mainly includes a microcontroller device, digital and analog pins, as well as other peripheral components. The proposed system is based on an R3 Board ATmega 328, in conjunction with an R3 Ethernet Shield. The integrated development environment (IDE) runs on a computing system and it is used to write and download the code

to the circuit board. IDE is based on a simplified version of C.

B. Overview of Home Automation Personal Assistant

This paper discusses the result of the work done in development of a "IoT – Personal Assistant using Raspberry Pi" on Python Platform. The work aims at the development of a personal assistant that helps users interact with household appliances using speech and gesture commands to provide a more interactive and user friendly living experience and integration of various tools and components developed during the execution of the project. The Internet of Things (IoT) can be described as a network of physical objects or "things" embedded with software, electronics, sensors and network connectivity that helps these objects collect and exchange data. The smart devices and sensors in home automation help collect (or sense) the physical experience and convert it into information data. The major element of home automation based on IoT is the Raspberry Pi. The Raspberry Pi collects data from sensors or takes in speech or gesture commands and interprets them to manage household devices like fan, light, heater, door, and opening and closing of curtains. For example, if there is no presence of a person in a certain room, the lights are automatically turned off for that particular room.

C. Overview of Home Automation using Rasberry Assistant

The overall design of Home Automation System (HAS) implements low cost wireless communication between a Raspberry Pi module and an android based application to the IP appliances present at home. This paper provides a combination of these two components--security and ease of lifestyle for people. This paper is designed to assist and provide support for all demographic. It introduces a smart home concept that improves the standard of living at home. The

paper is intended to control electrical appliances in a home or office using an android application. The main control system implements wireless technology to provide remote access from raspberry pi. The paper mainly focuses on the monitoring and control of smart home remotely and providing security, when the user is away from home. The paper is intended to control electrical appliances and devices in the house with relatively low cost design, user-friendly interface and ease of installation. This paper differentiates itself from others as it has its own software level application to control the home appliances. In this paper android phone is used to control the various parameters.

III. PROPOSED SYSTEM

A. System Design Overview

The design aspect mainly has three main parts:

- The voice assistant which listens to the instructions, converts to text and sends it to local host server present on Pi board.
- The second part is the isolated Wi-Fi slave modules which are fitted at the socket boards where electrical loads are manually controlled and the modules take instruction from the localhost server.
- The third part is bridging the input with the output. The automated script on Pi compares the input with the already fed data and executes the output instruction through GPIO pins of the Wifi slave modules.
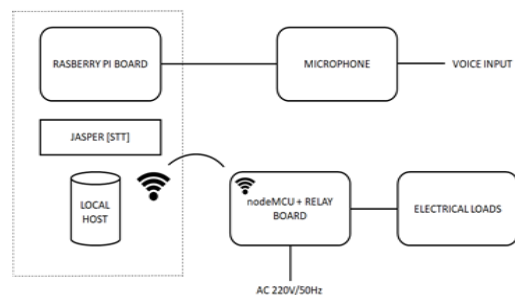

Fig 1. System design overview of Smart Home Automation using Rasberry Asistant

B. MQTT Protocol

MQTT (MQ Telemetry Transport) is a lightweight messaging protocol that provides resource-constrained network clients with a simple way to distribute telemetry information. The protocol, which uses a publish/subscribe communication pattern, is used for machine-to-machine (M2M) communication and plays an important role in the internet of things (IoT). The MQTT protocol is a good choice for wireless networks that experience varying levels of latency due to occasional bandwidth constraints or unreliable connections. The MQTT protocol surrounds two subjects: a client and a broker. An MQTT broker is a server, while the clients are the connected devices. When a device -- or client -- wants to send data to a server -- or broker-- it is called a *publish*. When the operation is reversed, it is called a *subscribe.*

C. Rasberry Pi

The Raspberry Pi is a low cost, **credit-card sized computer** that plugs into a computer monitor or TV, and uses a standard keyboard and mouse. It is a capable little device that enables people of all ages to explore computing, and to learn how to program in languages like Scratch and Python. It's capable of doing everything you'd expect a desktop computer to do, from browsing the internet and playing high-definition video, to making spreadsheets, word-processing, and playing games.

Fig 2. Rasberry Pi chip

D. nodeMCU

Since NodeMCU is open source platform, their hardware design is open for edit/modify/build. NodeMCU Dev Kit/board consist of ESP8266 wifi enabled chip. The **ESP8266** is a low-cost Wii-Fi chip developed by Esp ressif Systems with TCP/IP protocol. NodeMCU Dev Kit has **Arduino like** Analog (i.e. A0) and Digital (D0-D8) pins on its board. It supports serial communication protocols i.e. UART, SPI, I2C etc. Using such serial protocols, we can connect it with serial devices like I2C enabled LCD display, Magnetometer HMC5883, MPU-6050 Gyro meter + Accelerometer, RTC chips, GPS modules, touch screen displays, SD cards etc. Use words rather than symbols or abbreviations when writing Figure axis labels to
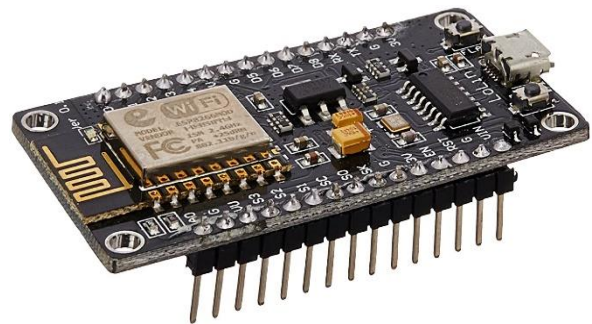
avoid confusing the reader.

Fig 3. nodeMCU chip

E. Relay Board

Relay board is a set of relays which can be connected together to a power source which will be triggered by the microcontroller outputs. Relays are also called electro-magnetic switch poles that make or break when there is small current flowing through the electro-magnetic coil.

Fig 4. Relay board

Fig 5. Working of Speech to Text Library

F. Speech to Text Library

- Bag of Words: This method is used to convert a text into a set of definite length of numbers as machines can read numbers. Hence repeated words are removed, so if we have three lines having 25 words, then after applying this method it reduces to 10.

- N-grams: N-grams are used to correlate the words in a sentence and how it makes sense of the content. It also reduces the uppercase to lowercase and special characters which otherwise would simply disturb the training weights.

- Term Frequency: TF gives us the frequency of the word in each document in the corpus. It is the ratio of number of times the word appears in a document compared to the total number of words in that document. It increases as the number of occurrences of that word within the document increases.
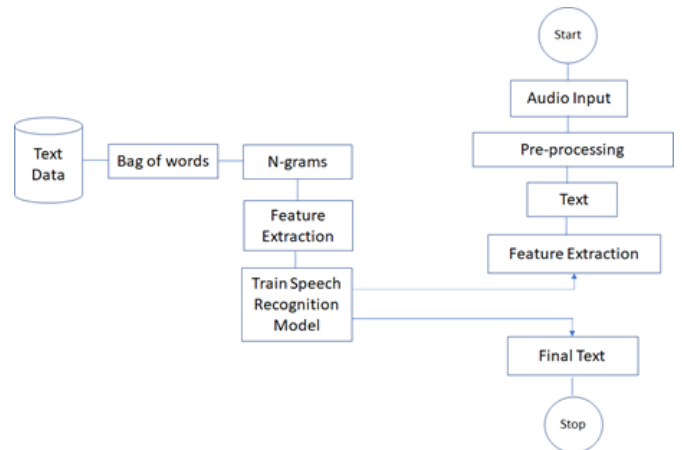
G. Working

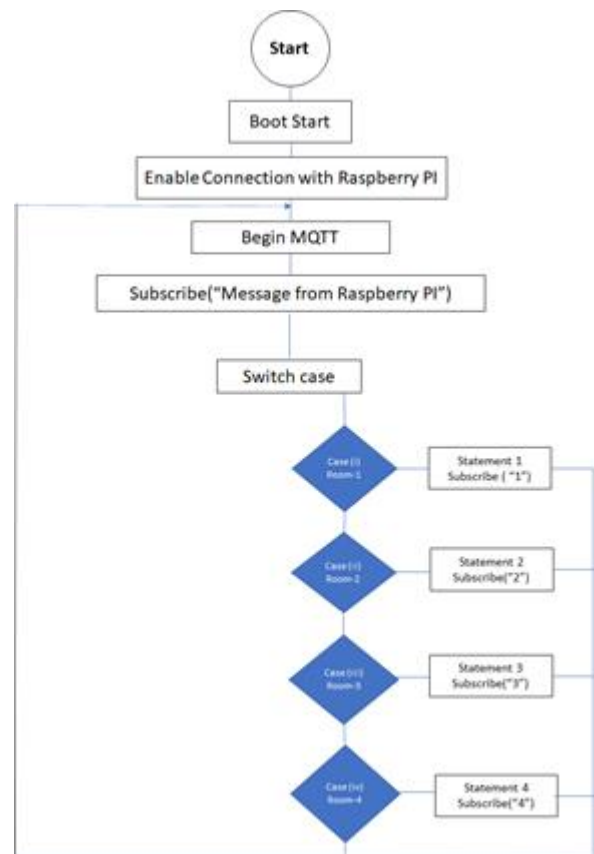Fig 6 depicts the working procedure of the proposed system.

Fig 6. Workflow of proposed system

As we mentioned in the introduction part proposed system utilizes Rasberry Pi to enable the connection. Rasberian operating system is used for the development of the system. Python scripting and Embedded C Language (Arduino C) are the

programming concepts which are used for the development. It mainly consist of three modules which are MQTT client, Time module, RPI GPIO. IDE used here is Arduino which consist of Adafruit MQTT Client, ESP8266Wifi module libraries.

H. Circuit Diagram

Fig 7 shows the circuit diagram of the project. The setup consists of a Voice assistant module and a nodeMCU board that can be fixed at the switch board socket. Both of which are connected with Wifi. The output GPIO pins are connected to different electrical loads through relay.
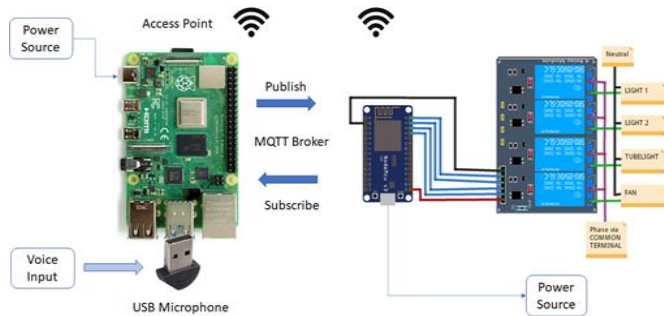

Fig 7. Circuit diagram of Smart Home Automation using Rasberry Assistant

IV. CONCLUSION

Methodology is being implemented on the components available in the open market. This gives us two main advantages :

- Access to easy and open-source information and help to solve problems that arise while developing and testing the project.
- The project can be customised according to the needs of customer requirements.
- The role of economics and easy procurements of components will have an added advantage.

The project's main objective was to design and develop a home automation system supported by voice assistant. One of the main concerns was data security making it private. We could achieve this by establishing connection between the Raspberry Pi and nodeMCU module through Wifi. The transfer protocol used here is MQTT protocol and exchange of information happens via Subscription and Publish. The STT library was able to successfully convert voice into text in Raspberry Pi. The text was interpreted and sent via the Wifi through MQTT protocol. The corresponding load was switched ON/OFF according to the voice input given. The project works fine with the voice as input and controlled electrical load as output.

V. REFERENCES

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