Personal and Intelligent Home Assistant to Control Devices Using Raspberry Pi

Shilpa H Baria[1] and Chintan Bhatt[1]

[1]Department of Computer Engineering, Charotar University of Science & Technology, CHARUSAT Campus-Changa
Off. Nadiad-Petlad Highway, Gujarat (India) 388 421 INDIA

Abstract: "*Personal Assistant-The word itself means assistant working exclusively for one particular person.*" Purpose of this type of Automation System and Artificial System is to reduce human labour, effort, time and errors due to their intelligence. Main work is to design and implement this personal home assistant in same device, which can access internet and can control to home devices. All tasks and services working on user related information are available to online sources at present location. Sensor devices in this system are used to control devices, to improve system security and to make accurate decisions. Personal Assistant is designed for making a user's life easier. This system uses voice recognition system to control different types of devices based on personal assistant. This type of system is a very important and useful today's worlds for the physically debilitated peoples. They are not capable to do different activities and to work to do efficiently at any place.

Keywords: Home Automation, Amazon voice service, Personal Voice Assistant, Raspberry Pi.

1. INTRODUCTION

Internet of Thing [26, 27, 28, 29] is the system equipped by all items on the earth that can recognize gadgets or machine effortlessly clear identifiers and it is change day by day life. IoT is combination of both hardware as well as software. Internet is main thing available in IoT. In the IoT we can access, control from anywhere and anytime. In the IoT, there are Machine-to-Machine communication, Machine to Human Communication and Human to Machine Communication are possible. Embedded devices are more important in IoT because of Data collection, Network Resource Preservation and Closed Loop Function. Growth of IoT is day-by-day increasing. "The Internet of Thing is the interconnection of uniquely identifiable embedded computing devices within` the existing Internet infrastructure. IoT is mainly concerned with making devices work with connected data over an internet. The data can be from different types of sensors, which are embedded with real environments. This data is then carried over the internet to its respective controllers. The controllers then process the data and send relative commands to the actuators. The sensors and the actuators both work on different environments. Therefore, they need to communicate with each other.

There are many applications based on IoT like Home Automation, Smart Agriculture, Smart Parking, Smart Education, and Smart Grid. In the IoT we are using IPV6 for the IP address. All devices in an IoT environment communicate with each other. The to-and-fro communication between sensors and actuators uses different protocols such as MQTT, CoAP, XMPP, REST, 6LowPAN etc. These devices are connected to the internet through capillary networks. From above data we can conclude that Internet of Things consists of multiple specialized hardware and software that perform specific functionalities through web APIs which uses various protocols to create seamless connection to internet so that sensory data system sense that data and control system can take action on actuators set on specific environment. The data sensed by the respective sensors can also be stored virtually in cloud from where it can be used by the user remotely to perform analytics and to derive the results. IoT is mainly developed into two technologies: wearable and embedded. The wearable devices are mainly developed using their own platforms depending on the developer.

E-mail:15pgce002@charusat.edu.in

The embedded platforms mainly use Arduino, Raspberry Pi, Intel Galileo, Intel Edison Netduino etc.

Voice Recognition is commonly used to operate a device, perform commands, or write without having to use a keyboard, mouse, or press any buttons. Today, this is done on a computer with **Automatic Speech Recognition** (**ASR**) software programs. It can more accurately convert the Speech to Text. For Example, Say "Open Internet" And The Computer Would Open The Internet Browser.

Voice Control Matters In today's life

Accessibility: When building apps, we should always keep in mind that not all users would have perfect vision. Voice control makes operating the application easier for users with visual impairments.

Safety: A hands-free interface is a huge convenience e.g. While driving a car or performing any other task that requires both hands and a high level of concentration. With the help of voice control, more users can operate our application at any time. Interaction: When building machines such as robots and moving vehicles, speech-recognition enables the user to communicate and control the devices easily. Computer Understand Our Voice. First, there is a need to understand the difference between Speech recognition and Natural language processing. Speech recognition converts spoken word to written text. Using a speech-to-text (STT) engine, we can dictate messages or emails to device and then send them. We can also use text-to-speech (TTS) techniques to imitate the voice. For example, with google translator's TTS can check how a word is supposed to sound. Natural language processing is a much more advanced field of Computer Science that is concerned with understanding the meaning of the user's phrase. It uses artificial intelligence and machine learning to catch what you actually meant when you spoke to the device. For this system, Natural Language Processing is the most important thing.

Example, if the brilliant home reminds the human to take his/her office envelope before leaving to work. Other case, the shrewd home can open the garbage door, the intelligent home brews the coffee when client is preparing in the morning. IoT turns out to be truly imperative in comprehension the environment and collaborating with its devoted Network. IoT can interface heterogeneous gadgets like washing machine, fridges, TVs, AC, radiators, movement identifiers, car parking door, and numerous different types of gadgets to gather information and take command to perform task.

Amazon echo developed a strong reputation for manufacturing high quality products, including tablets, e-readers and laptops. While Siri stays in pocket all day and can help with all tasks. Siri cannot manage home appliances; Amazon Echo can easily control light bulbs, smart switches, laptops, TVs and home cinemas. Android users can use Echo, while exclusively iOS users can only use Siri. Microsoft's Cortana is a well-framed virtual assistant specially designed for windows 10.This type personal assistant works only on smart phone and computers with windows 10 installed. Amazon and Google are two of the most powerful companies in the world, along with huge names like Apple, Microsoft. The most important feature of Google's Now and probably its advantage over Amazon Echo and over all other virtual assistant is that it connects to Google account, enabling to set alarms, set reminders, check the weather, get access to Gmail account, check the embedded map for the best route to the airport etc. Only Echo can give answers without the touch of a button or without touching Smart phone.

One of the most highly visible and popular system of Internet of Thing is the smart thermostat system. It is connected with the internet. We will automatically adjust the temperature based on our status weather we are home at away, awake and asleep, hot or cold. Thus, it makes our home more efficient and it can help us to save heating and cooling bills. The mobile application allows edit schedules, change the temperature when we are away from home, and even receive alerts in any problem related to heating or cooling system.

There are mainly two types of temperature sensor are in embedded world: Contact sensor-In which sensor should touch with object or any physical part of system to get correct temperature and Contactless sensor-In this sensor, without touch, it can sense temperature and get result which is required. In cold storage type application, we can use contactless sensor.

In the market, new latest voice based smart home device available by the Amazon, the product name is "Amazon Echo". Amazon has been building up a home automation to help client to arrange things with simply voice.

The Echo has multi-shaded lights that demonstrate the human that it is tuning in. It illuminates the human gives when the wakes up and when order. Echo have comparative design of related Nest thermostat. Amazon Echo is a dedicated gadget, which is associated with the user's accessible setup Home Internet. Amazon cloud server is a gathering of every accessible service as voice preparing server, scanning for human prerequisites, login administrations, and other data.

2. LITERATURE REVIEW

One system available on ARM Cortex-A8 processor, it is under embedded to Linux operating system already developed for its related performance and measurement on a real-time set-up. Voice recognition module and camera are used this system as

input devices. This type of voice control can be efficient in the indoor environment without more background noise. A home IoT gadget has a straightforward capacity to control things in the home condition [1]. If the home equipment are command by unapproved voices, it is dangerous for home security. Hence, introduction of security is needed. There are numerous security advancements in different fields that can be implanted into an IoT gadget. Among these technologies, the best security technology is the biometric recognition technology to be utilized. It can be expected to increase security and convenience by applying Speaker Recognition through this biometric recognition technology [2]. However, Echo cannot capable to cover entire home, this great digital companion works perfect if you are in a room or in the adjacent room. Additionally, it is not portable and requires batteries to operate. This voice-activated personal assistant relies upon Alexa, an examination and pursuit benefit. Then again, Siri can be conveyed with you since it lives inside your cell phone. Best of all, Echo is use in any Android users, while Siri use only in iOS users [11].

Alexa, Echo's engine, can work on various tablets and devices, encouraging new developers to design apps that work together with it. On the other hand, Siri works only with iOS devices. Echo will continue to be integrated with top companies around the world, while Siri is losing its interest among consumers who do not own an iPhone.

When Microsoft launched Cortana, it was promoted as taking the top pros from Now and Siri, and that is partially true. Cortana falls behind in its integration with the most important third-party apps available on the market. Until Microsoft Cortana will be available on Android and iOS devices, it remains the only good option for systems with Microsoft Windows 10 installed.

Voice recognition system can be translation of user-spoken words into the text. Voice recognition support as ASR model, this technique offers to recognize all speech automatically. Speech recognition system different types, some of the system speaker independent and other system utilize to training method. Training method uses this type of system, which is referred as "speaker-dependent systems" .Now a day Speech recognition can be used in different areas. Its most important applications are aircrafts, speech-to-text processing, simple data entry, call routing, smart search, etc. Speech recognition mostly depends on the statistical models. This models transfer speech into text form and vice versa. Different type of statistical model available and used in this type of system are acoustic model, language model, lexicon model, hidden markov models. Voice controlled personal assistant is capturing photos and recognizing

faces in the captured photo, checking similarity between two faces. It is also performing arithmetic calculations based on voice commands and giving back the computed solution through a robotic voice.

TABLE 1.COMPARISON OF VOICE ASSISTANT

Intelligent Personal Assistant	Developer	Retail Price	IoT	Smart Phone app
Alexa Echo	Amazon	S$79	YES	YES
Cortana	Microsoft	-------	NO	YES
Google Assistant	Google	S$29	YES	YES
Siri	Apple Inc.	-------	NO	YES

3. TECHNOLOGY IN DETAIL

IoT is created by enabling machine-to-machine interactions; another important factor of IoT is the human-machine interaction. By creating a connected life, people can interact with their devices, appliances, vehicles, etc. As one of the most natural ways of communication, using speech to interact with things adds value by enriching the user experience.

As a subset of Internet of Things, smart/connected home is a fast growing industry that includes automation of household activities (e.g., centralized control of lighting, heating, air conditioning, etc.) for more convenience, as well as for added security (e.g., control of alarm system, doors, windows, etc.). This work focuses on a combination of speech recognition and natural language understanding for smart home applications with customizable devices. Dynamic hierarchical language models are discussed and shown to be effective in creating personalized speech recognition, and evaluated in terms of both word accuracy and semantic accuracy. Internet of Thing is developed with many technologies as cloud computing, big data, robotics and different communication technologies. In voice recognition, systems use many methods and strategies. Mostly voice recognition system use Hidden Markov Models, this is easy and simple to trained and use. House manufactured devices can be communicated using ZigBee. In the industry, some company uses Wi-Fi as its base wireless system network. Bluetooth networks are also used in IoT based wireless network. Apple's home kit, Samsung's Smart Things platform, and AT&T's home automation solutions are the example of smart home system. Comcast also has its own home automation system. Each has its own devices talking to each other. Thus, standardization is very fragmented in current times, which include Bluetooth, WI-Fi, ZigBee, Infrared or

more remote methods to frame a dedicated little system of Internet of Things.

Now days, Wi-Fi is the innovation to associate heterogeneous type of computer devices. It is the most widely recognized innovation to interface an adequate size system in LAN, other computer, it desktop, portable PC, advanced mobile phone, tablet with Wi-Fi capability and also a latest technology ZigBee and X10 is devoted network which required extraordinary devices to create a network, ZigBee wants ZigBee Router, ZigBee controller, and ZigBee enabled devices.

X10 requires different type of transmitter and receiver for the sending an information to the devices in Analog mode. The cheapest wireless technology is a Wi-Fi. In the Wi-Fi device, dedicated router is not needed to make a virtual Wi-Fi router as its own secured Network, filling in as a Hotspot. So that Wi-Fi is most probably use in other type of home automation. The controller gadget can be utilized to coordinate capable cloud servers to control the home mechanization. 'Access Point' or a Repeater are used to increase the range of the network. So, that we can increase the range of Wi-Fi network.

Clear Voice vastly improves automatic speech recognition (ASR) for voice command and control user interfaces (UI) and artificial intelligence (AI) driven natural language processing (NLP) found in services such as AVS, Cortana and Google Assistant. The joint demonstration shows Clear Voice-powered AVS integration and voice activated` IoT control for a range of home IoT applications. Clear Voice offers broad hardware platform support and highly optimized CPU and memory utilization for easy system integration with reduced cost and complexity. It supports single microphone and arrays from 2 to 8 or more microphones. Now a days, cloud computing is immense. The controller gadget can be utilized to coordinate capable cloud servers to control the home computerization system. Here the case is voice.

4. OBJECTIVE

The main objective of this system is to control any devices (it should be any type of device as like IoT compatible device or a simple appliance) through the voice by using the very popular technology Internet of Things. The aim is to make personal assistance to do anything by speech. Other main purpose is to save the power. Sometime human forgot to switch of the devices and man outside the house using this kind of IoT system to control device from anywhere in the word so that power can be saved from anywhere.

5. SYSTEM DESIGN

Working of system is: At first, voice recognized by the Alexa pi, Using Internet Alexa pi send voice command to IFTTT and IFTTT directly connected with our MQTT Broker, this broker give signal to client, the client give operation on relay module to control appliance

Voice recognition devices: Here smart personal assistant is a software agent. IPA (intelligent personal assistant) can perform errands and administrations for an individual its related tasks. These task and services are rely on upon client input, location of clients, and the capacity to get to data from an assortment of online sources. Cases of such an operator are Amazon Alexa, Siri from Apple's, Samsung's voice Google Now, Microsoft's Cortana, and this system can be classified into modules and they are use different type of voice services and devices.
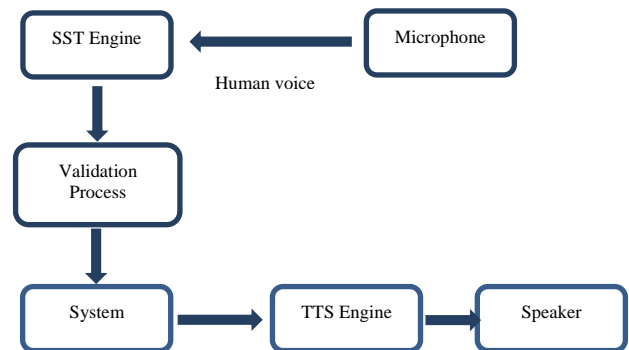

Figure 1. Block Diagram of Speech Recognition Module

Setting up a Microphone for the Alexa Voice Input: User voice is given as input, inbuilt to the microphone in raspberry pie circuit. This circuit converts the voice signal into electrical signal and then after send to the speech recognition module. This system uses the relay module; this module to system will take on/off devices decision with the help of power control module. The raspberry pi allows this type system to store the status of all the uses appliances into a file and store them in server, this server will act as a system database. In this system, MQTT protocol is easy to implement and it comprises of one Broker and multiple clients where clients can be treated as our smart phone, sensors, etc. and they all communicate with the server, which is known as Broker. Also in this protocol, every client need to connect to any address of the broker, which is known as the topic to be subscribed in MQTT. In single broker, there can be multiple topics and clients can subscribe to multiple topics of the same broker. The user can turn on/off sending a message using keyword or by pressing the button in the application. This system has various aspects like entertainment,

computation, face recognition and security. This system can help the visually impaired to connect with the world by giving them access to Wikipedia, calculator email and music all through their voice. This system can also keep people secures as it can be used as a surveillance system which captures the face of the person standing at the door.

Alexa PI Setup (Raspberry pi3 + Amazon Alexa Voice Service):

Step 1: Make Amazon developer account at developer.amazon.com. After completing developer account Create a device and security profile in which I gave ProductID (also known as Device Type ID), ClientID, and ClientSecret.

Step 2: clone the sample app in raspberry pi 3.

Step 3: Update the install script to filling client ID, Secret and Product ID,

Step 4: Run the install script and web service, sample app and wake word engine Completing all step it complete to taking with Alexa it is call as Alexa Pi

Proposed System architecture

As show in the design, this voice recognition is to control devices represented. The system consists of a raspberry pi 3, API, MQTT server, ESP8266 node MCU. In this system, use Alexa voice service, this service first install in raspberry pi 3.Alexa voice service is one type of cloud service, Alexa voice service runs to the client, than online access to the refresh token.
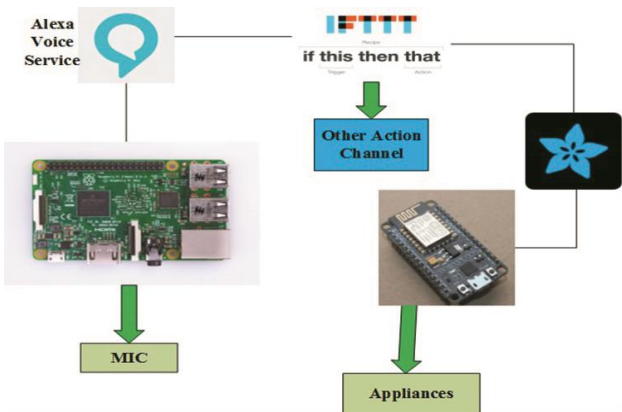

Figure 2. Block Diagram of Home Assistant to Control Devices Using Raspberry Pi

In this system, Alexa Pi make and press the button than user speak kitchen light turn on than this statement recorded and after release this button than send to this phrase Alexa voice service on amazon server. Alexa voice service use voice recognition to recognize this phrase and this service authenticate to check this device registered or not. After checking this phrase AVS send this phrase to its related specific API. For example, we say Alexa trigger play music on my phone, than this recorded phrase send to the Alexa voice service, this service recognize to find which API to send. This phrase send to the IFTTT trigger, IFTTT recipe also connect to the android device. This connectivity is possible to google account for registration in android device. This system automatically operates on my phone, than playing music on my phone is possible. This system is to on/off bulb, fan, Fridge, Door etc.

6. IMPLEMENTATION

The whole idea of smart home assistance for controlling using IoT provides access to control and monitor vital parameters of the devices (AC, Heater ect) through Alexa voice service and MQTT Server, And Subscriber, of a multi-level IOT platform. The starting of the project to make voice recognizance or personal assistance. In the market so many voice recognize personal assistance available as like Siri, Cortana, Google Assistance, Wit.ai, Api.ai, IBM Watson, Amazon Alexa, but we implement our own "ALEXA PI" by using Amazon voice **services (**AVS). The Raspberry Pi can easily run the Alexa Voice Service, MQTT broker among other things. Here is the first step to implement personal voice based home assistance. For that, Raspberry pi 3 is used. It is portable, affordable and low power consumption with Raspberry Pi at the core.

We walked through downloading Raspbian Jessie and boot the SD card. This bootable SD card put in the Raspberry pi 3 and connecting the hardware setup to complete setup of raspberry pi 3. After completing raspberry pi 3 setup Install Alexa Voice services to make voice control personal assistance to further controlling the different devices. Affordable low cost ALEXA PI working as personal assistance, now go to next step, the main purpose of next step is to control appliance. First, we need MQTT broker. So many Broker Available but we have used Adafruit MQTT broker. It is quite simple Adafruit.IO MQTT Broker:

http://io.adafruit.com Sign up in this site and create a new feed. This feed can be accessed with any MQTT client; you must remember your feed name, user name, and secret key. IFTTT: Integrate API with IFTTT to do amazing stuffs like, controlling appliance and do get feedback on our phone via SMS. Here I use IFTTT for connection between Alexa PI and Adafruit IO, After completing broker side last and final step to set up Client, for project, we used the ESP8266 12e

development as client, At Last, connect relay module with the ESP8266 12e GPIO Pin to connect number of appliance. For example, create recipes in IFTTT. This triggers to play music on my phone.
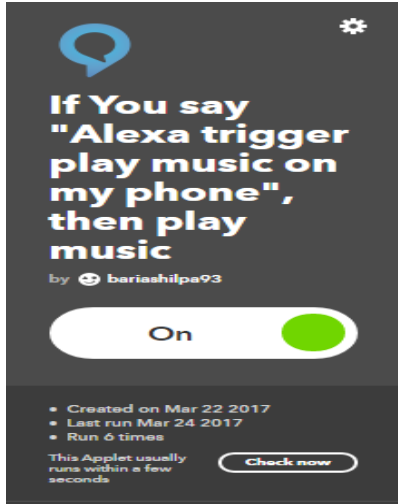

Figure 3. Created recipe in IFTTT

Than we say play music on phone, that time automatically smart phone is operated and play music on android devices.

7. RESULT

After completing full setup of Alexa pi and all hardware connection with Alexa pi, take output from this personal assistance. Run Alexa voice service as per figure no three.
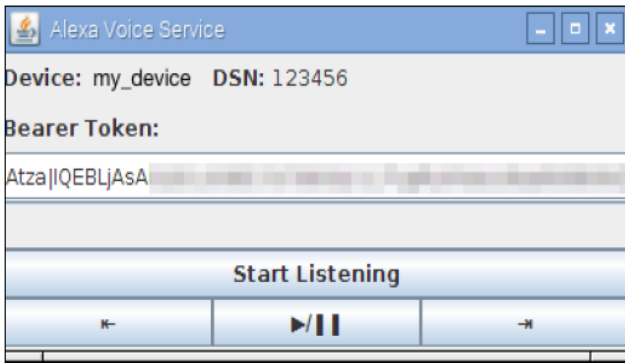

Figure 4. Run Alexa voice service in raspberry pi 3.

Give any voice command to Alexa pi as like an "Alexatrigger bulb off" Alexa give signal to IFTTT API and IFTTT connect send phrase to MQTT Adafruit IO. Adafruit IO connect the client. Here the connection between Adafruit IO and ESP8266 12e development as client to control devices is also shown.
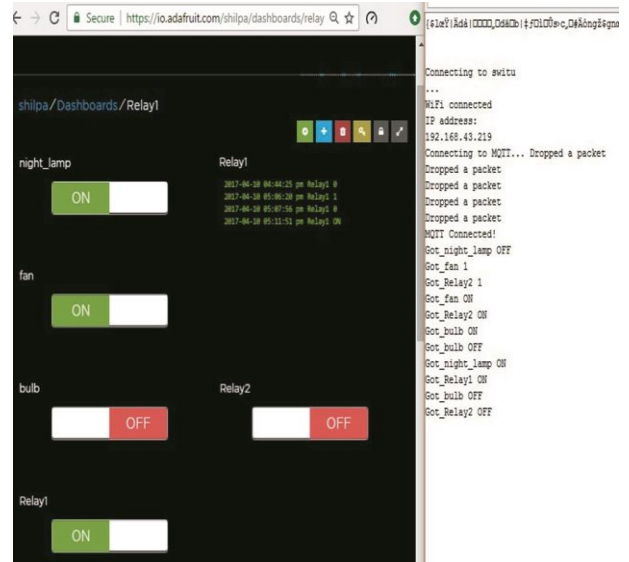

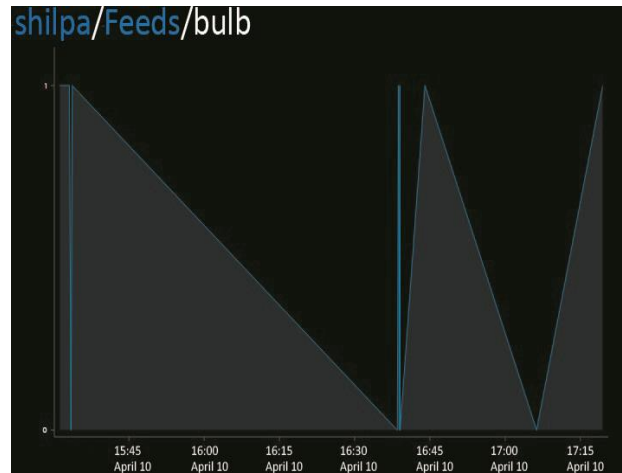Figure 5. Serial monitor and Adafruit dashboard side by side.

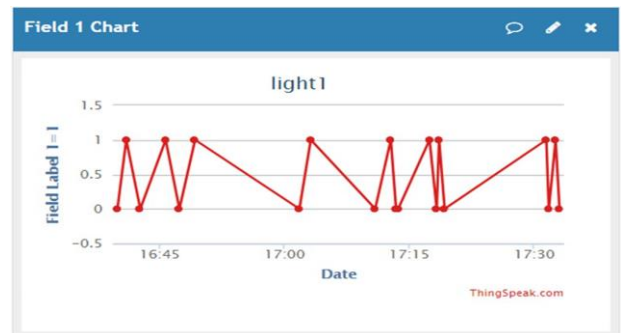Figure 6. Bulb Operation Graph in Adafruit dashboard

Figure 7. Light1 operation graph

8.   CONCLUTION

This system use voice recognition system to control different types of devices based on personal assistant. This type of system is a very important and useful in today's worlds for the older and other physically incapacitated people. They are not able to do different activities and work efficiently at home or at any other place. Use of this type of voice recognition system important because lots of power saving is possible. In addition, it is extremely adaptable, good utilizing with future advances. This type of voice recognition system can give secure and reliable access to home/office. Security is very essential now a day.

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Shilpa Baria: Received her M. Tech. degree in Computer engineering from Charotar University of Science & Technology, Gujarat (India), in 2017.Currently, she is demonstrator at the Department of Computer engineering, Her major research interests include Internet of things for smart home.

Prof. Chintan Bhatt (Ph.D.*) is currently working as an Assistant Professor in Computer Engineering department, Chandubhai S. Patel Institute of Technology, CHARUSAT. He is member of IEEE, EAI, ACM, CSI, AIRCC (Academy & Industry Research Collaboration Center) and IAENG (International Association of Engineers). His areas of interest include Internet of Things, Data Mining, Web Mining, Networking, Security Mobile Computing, Big Data and Software Engineering. He has more than 5 years of teaching experience and research experience, having good teaching and research interests. He has chaired a track in CSNT 2015 and ICTCS 2014. He has been working as Reviewer in Wireless Communications, IEEE (Impact Factor-6.524) and Internet of Things Journal, IEEE, Knowledge-Based Systems, Elsevier (Impact Factor-2.9) Applied Computing and Informatics, Elsevier and Mobile Networks and Applications, Springer. He has delivered an expert talk on "Internet of Things" at Broadcast Engineering Society Doordarshan, Ahmedabad on 30/09/2015. He has been awarded Faculty with Maximum Publication in CSIC Award and Paper Presenter Award at International Conference in CSI-2015, held at New Delhi.