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Using Google Assistant and Raspberry Pi Multilingual Home Automation

1.Prof Sangamesh S K, 2. Prof Pavitra M G, Prof Shweta M.N
Department of Computer Science and Engineering,
RTE Society's Rural Engineering College Hulkoti

Abstract-*One of the problems with a voice-controlled smart home automation system is the language barrier. Most of the existing home automation systems support only a few languages, including English. Hence, we aim to make an Internet of Things (IoT) home automation system that allows you to control your home devices with voice commands in your preferred language like Hindi, Bengali, Marathi, and so on. It uses Google Assistant to control smart devices at home and also supports all the languages supported by Google Assistant. Also an Android app for a smart touch control system will bedeveloped for remote touch control of the devices*

INTRODUCTION

The Internet of things (IoT) describes physical objects (or groups of such objects) that are embedded with sensors, processing ability, software, and other technologies that connect and exchange data with other devices and systems over the Internet or other communications networks.[1][2][3][4]

The field has evolved due to the convergence of multiple technologies, including ubiquitous computing, commodity sensors, increasingly powerful embedded systems, and machine learning.[1] Traditional fields of embedded systems, wireless sensor networks, control systems, automation (including home and building automation), independently and collectively enable the Internet of things. In the consumer market, IoT technology is most synonymous with products pertaining to the concept of the "smart home", including devices and appliances (such as lighting fixtures, thermostats, home security systems and cameras, and other home appliances) that support one or more common ecosystems, and can be controlled via devices associated with that ecosystem, such as smartphones and smart speakers. The IoT can also be used in healthcare systems.[5]

There are a number of concerns about the risks in the growth of IoT technologies and products, especially in the areas of privacy and security, and consequently, industry and governmental moves to address these concerns have begun, including the development of international and local standards, guidelines, and regulatory frameworks.[6]

History

The main concept of a network of smart devices was discussed as early as 1982, with a modified Coca-Cola vending machine at Carnegie Mellon University becoming the first ARPANET-connected appliance,[7] able to report its inventory and whether newly loaded drinks were cold or not.[8] Mark Weiser's 1991 paper on ubiquitous computing, "The Computer of the 21st Century", as well as academic venues such as UbiComp and

PerCom produced the contemporary vision of the IOT.[9][10] In 1994, Reza Raji described the concept in IEEE Spectrum as "[moving] small packets of data to a large set of nodes, so as to integrate and automate everything from home appliances to entire factories".[11] Between 1993 and 1997, several companies proposed solutions like Microsoft's at Work or Novell's NEST. The field gained momentum when Bill Joy envisioned device-to-device communication as a part of his "Six Webs" framework, presented at the World Economic Forum at Davos in 1999.[12]

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The concept of the "Internet of things" and the term itself, first appeared in a speech by Peter T. Lewis, to the Congressional Black Caucus Foundation 15th Annual Legislative Weekend in Washington, D.C, published in September 1985.[13] According to Lewis, "The Internet of Things, or IoT, is the integration of people, processes and technology with connectable devices and sensors to enable remote monitoring, status, manipulation and evaluation of trends of such devices."
The term "Internet of things" was coined independently by Kevin Ashton of Procter & Gamble, later MIT's Auto-ID Center, in 1999,[14] though he prefers the phrase "Internet for things".[15] At that point, he viewed radio-frequency identification (RFID) as essential to the Internet of things,[16] which would allow computers to manage all individual things.[17][18][19] The main theme of the Internet of things is to embed short-range mobile transceivers in various gadgets and daily necessities to enable new forms of communication between people and things, and between things themselves.[20]

Defining the Internet of things as "simply the point in time when more 'things or objects' were connected to the Internet than people", Cisco Systems estimated that the IoT was "born" between 2008 and 2009, with the things/people ratio growing from 0.08 in 2003 to1.84 in 2010.[21]

Applications

The extensive set of applications for IoT devices[22] is often divided into consumer, commercial, industrial, and infrastructure spaces.[23][24]

Consumer applications

A growing portion of IoT devices are created for consumer use, including connected vehicles, home automation, wearable technology, connected health, and appliances with remote monitoring capabilities.[25]

Smart home

IoT devices are a part of the larger concept of home automation, which can include lighting, heating and air conditioning, media and security systems and camera systems. [26][27] Long-term benefits could include energy savings by automatically ensuring lights and electronics are turned off or by making the residents in the home aware of usage.[28] A smart home or automated home could be based on a platform or hubs that control smart devices and appliances.[29] For instance, using Apple's HomeKit, manufacturers can have their home products and accessories controlled by an application in iOS devices such as the iPhone and the Apple Watch.[30][31] This could be a dedicated app or iOS native applications such as Siri.[32] This can be demonstrated in the case of Lenovo's Smart Home Essentials, which is a line of smart home devices that are controlled through Apple's Home app or Siri without the need for a Wi-Fi bridge.[32] There are also dedicated smart home hubs that are offered as standalone platforms to connect different smart home products and these include the Amazon Echo, Google Home, Apple's HomePod, and Samsung's SmartThings Hub.[33] In addition to the commercial systems, there are many non-proprietary, open source ecosystems; including Home Assistant, OpenHAB and Domoticz.[34][35]

2.LITERATURE SURVEY

I. Multi Language Voice Control Home Automation System – This paper describes remote control of household electrical outlets using a mobile phone as a transmitter which is further connected via bluetooth link to the receiver featuring a bluetooth receiver module, microcontroller and relay board. The system targets disabled people who cant easily reach the switch boards for controlling the devices. The system features multilingual voice control by developing an android app for

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same.

II. Home automation system using internet of things – This paper focusses on achieving remote control of household device using the IoT (Internet of Things) concept. The system features complete home automation including – device control, surveillance, and WSN (wireless sensor networks) for intrusion detection, monitoring etc. The system specifies use of MQTT protocol for its operation.

III. Smart Home Automation System using BLE - This paper presents technology which deals with low cost and efficient for example Bluetooth technology for controlling yeelight. This is achieved by incorporating java code into artik board. Technology has been developed at a high pace. Furthermore, it will never stop. Web of Things is getting to be prevalent nowadays because of putting tremendous effects on life. To structure an item utilizing current technology that ought to be gainful to the lives of others is an extraordinary test now a world. This paper exhibits cost effective technology for example ble, an artik board, yeelight, and test system simulator. The test system is utilized to control the shade of the yeelight in the scope of ble. The wireless communication has been established between the light and the board. This entire procedure will be incorporated according to popular request/response in accordance with the JSON format. The advantages of the light are it possesses low cost with less utilization of power.

IV. Literature Review on Home Automation System - This paper deals with discussionof different intelligent home automation systems and technologies from a various features standpoint. The effort targeted on the home automation concept of where the controlling and monitoring operations are expediting through smart devices. Wide-ranging home automation systems and technologies considered in review with central controller based (Arduino or Raspberry pi), cloud-based, Bluetooth-based, SMS based, ZigBee based, mobile-based, RF Module based, web based and the Internet with performance.

From above survey we analysed that most of the systems were designed utilizing BT/BLE/XBEE/WiFi systems and while some of the systems do provide voice control but they lack in providing multilingual voice control of the connected home appliances.

Further from the survey analysis we have concluded to provide below listed functionality to the home automation system with administration features to add more device control capabilities.

1. 2 x Electrical appliance control via smartphone voice commands or touch controls.
2. Integration with Google Assistant for multilingual support including – Hindi, Kannada, Marathi, Tamil, Malayalam, Gujarati, Bengali, etc.
3. Local WiFi operation of the complete system.
4. Additional device management and configuration via dedicated admin control panel.
5. Optional long distance remote control via dedicated VPN connection.

3.PROBLEM STATEMENT

One of the problems with a voice-controlled smart home automation system is the language barrier. Most of the existing home automation systems support only a few languages, including English In this DIY project, we are going to make an Internet of Things (IoT) home automation systemthat allows you to

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control your home devices with voice commands in your preferred languagelike Hindi, Bengali, Marathi, and so on It uses Google Assistant to control smart devices at home and also supports all the languages supported by Google Assistant. We will also make an Android app for a smart touch control system.

4.SYSTEM DESIGN

The system designed is based on a Raspberry Pi zero W SBC and Google assistant. The voice commands received by Google assistant are processed and redirected to the Raspberry Pi's IP address to achieve switching control of connected devices. Additionally an android app will be developed to achieve wireless remote touch control of the connected appliances

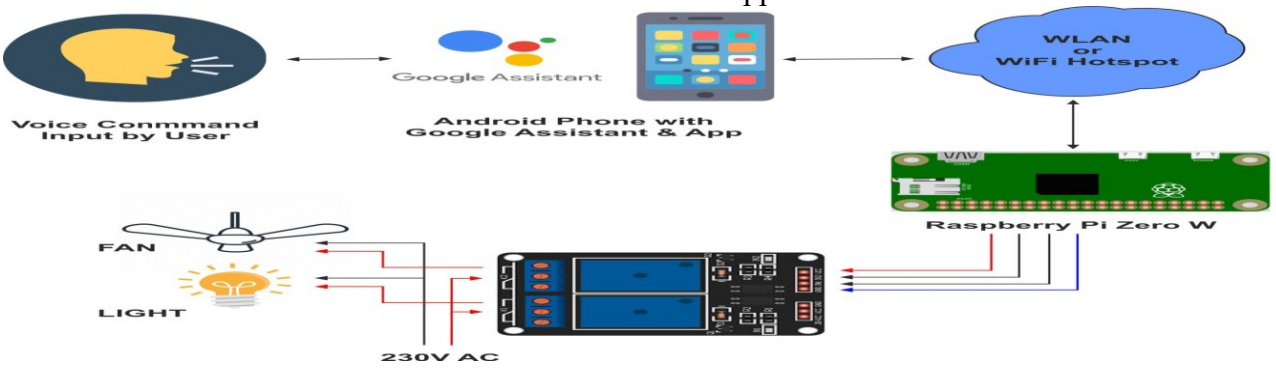

Fig. 1. Complete system block representation

As seen from the block representation the voice commands input by the user is processed by Google Assistant and further if a valid command is found then the same is forwarded to the Raspberry Pi Zero W using a WiFi network or hotspot hosted by the android device itself. The same is processed by the Raspberry Pi running the PHP script and switches ON
or OFF the connected load via its GPIO port using python scripts, further connected to a 2channel relay board and the 230V AC load connected to it.
We will be designing the system with 2 loads control for cost control factors and the samecan be further expanded to more number of loads, with minor hardware and software changes.

4.1 Software Design

The system software design is split in two different parts namely – System control softwareand Android control app. The first one will be responsible for achieving complete voice and touch control of the connected devices via Google Assistant and Android App, and includes a web server running PHP server side script on the Raspberry Pi Zero W which also features a device administration interface and local database in MySQL for storing device control parameters. The later one is an android app featuring remote touch controlof the connected devices.
The Google Assistant features routines for routing voice commands to any device or application and is configured to access PHP scripts running on the Raspberry Pi Zero W, based on different voice commands. Thus the system invokes PHP scripts based on voice commands and controls the connected devices via the GPIO interface using python scriptsof Raspberry Pi Zero W. The Raspberry Pi runs an Apache web server instance for serving PHP scripts for control purposes and also runs the MySQL database server which stores the device configurationand status.

Before we begin making hardware connections and programming, we need to prepare the Raspberry Pi SBC with following installation and configuration procedures:

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1. Raspberry Pi OS installation and configuration
2. Apache server installation and configuration
3. PHP installation and configuration
4. MariaDB (MySQL) server installation and configuration
5. PHP MyAdmin installation and configuration
6. Python MySQLDB connector installation
7. PureFTPD FTP server installation and configuration

Next steps will involve:
1. Making hardware connections
2. Database creation
3. Programming PHP & Python scripts, testing via localhost and WLAN clients
4. Automatic script execution configuration
5. Building and testing the android APP
6. Google Assistant configuration

Raspberry Pi Zero 2W Single Board Computer [36]

Raspberry Pi Zero 2 W is the most recent series of Raspberry Pi models and is an excellent choice for users looking for a small device that is significantly less expensive than other Raspberry Pi models. The device is pretty useful because it can be used to make various projects such as a doorbell, thermostat, and so on. This variant of RaspberryPi single board computer was chose in our project because of low power consumption, performance, small footprint and lower cost compared to other variants of Raspberry Pi SBCs.

Fig. 3. Raspberry Pi Zero 2W Single Board Computer

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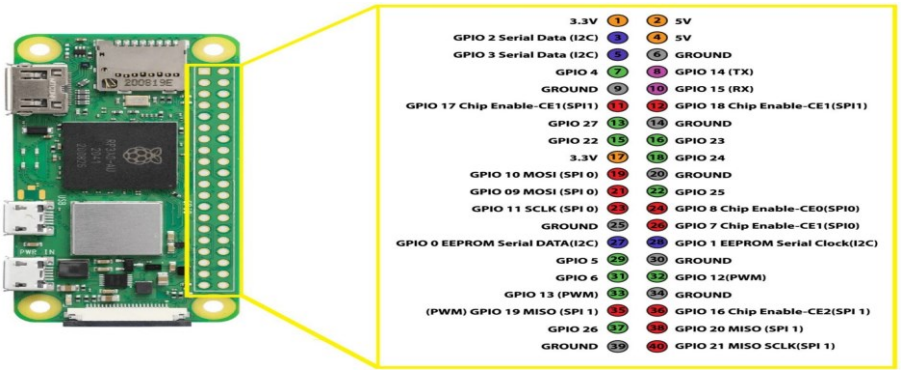

Fig. 4. Raspberry Pi Zero 2W GPIO Header Pinouts

Raspberry Pi Zero 2 W Design and Build

The Raspberry Pi Zero 2 W module has relatively smaller dimension and layout as compared to the original model. To connect the LCD screen to the device, you'll need an HDMI port, and to power it up, you'll need a micro USB power source to plug into the device's supply port. Another USB option is available if you wish to utilize a USB device totransmit data from your device to your desktop PC or as an external device storage. An SD card slot is built into the device's top, where you can simply insert your SD card and run the OS

GPIO Header

For those users who prefer to create different projects on Raspberry Pi, the GPIO header option is also available but it is unpopulated in order to save space on the device. If you want to create projects, you will need to use the solder to connect wires with the pins which you are going to use and it is going to become a little tough for beginners but the main point is that you will be able to learn soldering which is good enough for the future.

Built-in WiFi and Bluetooth

The WiFi is already enabled so you don't need to put effort in enabling it from the configuration settings and connecting an ethernet cable with the device to access the Internet. The Bluetooth option is already installed, which saves your efforts in installingpackages to enable the Bluetooth module on the device.

Processing Speed

The device contains a four core ARM Cortex A53 processor and the processing speed of CPU clocks at 1GHZ. Not only with that the 512MB RAM is included in the device which further boosts the performance of your system. With this much processing speed, you will
be able to enjoy your favorite Raspberry Pi desktop in it and can surf the internet freely.

Table 1. below shows the technical specifications of the single board computer.

Specs	Description
Processor	ARM Cortex A53 1GHz
Memory	512 LPDDR2
WiFi	2.4GHz IEEE 802.11b/g/n LAN
Bluetooth	4.2
Input Power	5V DC / 2.5A
Form Factor	65x30mm

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Connectivity	Mini HDMI, Micro SD card slot, 40 Pin I/O

Table. 1. Raspberry Pi Zero 2W technical specifications

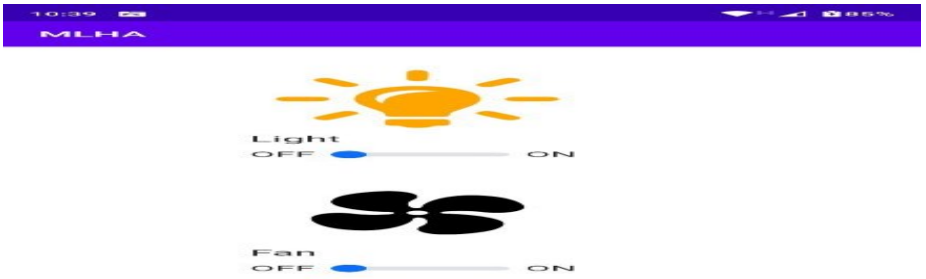

Fig. 34. Android APP target UI

Google Assistant Configuration

Our automation system is based on Google Assistant and we utilize the Assistant's Routines to achieve multilingual voice control of connected device. The configuration ofGoogle Assistant on any Android smartphone is detailed below (in our testing we have **used an Android 11 device and setting steps may vary on different devices):**

Step 1: Open Google Assistant and tap anywhere on the suggestions.

Step 2: Next tap on the user profile icon on top left corner of the prompt and then on the next screen tap on "Routines".

Step 3: Tap on the "New" button and tap on the routine name and then type in a suitable name like "Light ON".

Step4: Next tap on "Add Starter" and tap on When I say to Google Assistant and on the next screen enter the voice command such as "turn on the lights", "lights on maadu", "lights on karo" etc. Always enter one voice command in the text area and tap on Add another and continue with the next voice command. And once done tap on the "Add Starter" button at the bottom right corner of the screen.

Step 5: now on the "Routines" screen tap on "Add action" button and tap on "Try adding your own" button. Next in the text area type in "go to http://192.168.1.12/setstate.php? d=light&s=1" (IP address of Raspberry Pi and device = light, state = on). Then tap on the top right tick mark to save the action and on the next screen tap on save.

Step 6: Similarly add routine for "Light OFF", "Fan ON", and "Fan OFF". Now after these steps when we invoke Google Assistant and say "turn on the lights" or whatever voice command we have assigned the Assistant will execute the command in the browser window.

CONCLUSION

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The Internet of Things involves an increasing number of smart interconnected devices and sensors (e.g. cameras, biometric and medical sensors) that are often non- intrusive, transparent and invisible.IoT has been bringing new set of technological changes in our daily lives, which in turn helping us to make our life simpler and more comfortable. Though IoT has abundant benefits, there are some flaws in the IoT architecture and its implementation. So the main observation of the paper is that IoT architecture will probably best be described by a reference model than a single architecture and that there will be many different as yet unknownapplications/services that will connect to the IoT applies also to object resolution mechanisms. IoT applications rely on a communication infrastructure for exchanging information so it is important from a public policy point of view to ensure that IoT applications, which include healthcare, energy management, transportation, or any other innovative applications, will benefit from a fair access to this infrastructure.

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