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Smart Home Automated System Using Raspberry-Piand Google Cloud Services

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Abstract: ***This paper represents the development of an automated system based on IoT, which can mainly be used in the home and some features can also be implemented in offices, banks, or schools. The main purpose of this project is to save time and manpower along with security and convenience, using Raspberry pi. The salient features of this automated system are gas leakage detection for safety purposes, motion detection for security purposes, and controlling the home appliances as per the user's need. The system takes command through voice as well as text as per the user's requirements using google assistant, which further sends a response to Raspberry-Pi via Firebase for the required action. DHT22 sensor is used for the measurement of temperature and humidity, room temperature and Humidity will be displayed through Google assistant. This system consists of Python as the main programming language by default, provided by Raspberry Pi. The system will detect human presence with the help of a motion sensor i.e, whenever a person enters the room, the motion is detected and automatically an alert message will be sent to the user via Google assistant.***

Keywords: IoT, Raspberry-pi, Google assistant, Firebase, Python, Dialogflow, Voice Recognition.

I. INTRODUCTION

In recent days, people have had busy schedules so this system will reduce manpower with increased security and convenience. Often we observe that people leave fans, Lights and other appliances turned-on, this system can turn off/on the lights and other appliances automatically by detecting the motion. The system also uses a motion sensor to detect human presence and a camera module that captures the image of the unauthorized person and sends it to the owner's phone via Google assistant. Using a gas sensor, this system can detect any gas leakage and send an alert message through google assistant. The system can be used in several places like banks, labs, hospitals, and another sophisticated automated system, which reduces the hazards of unauthorized entry. We implement Raspberry pi which is a high-performance, low-cost computer. Google API is used to recognize the voice commands. It receives the commands and tells the system through a real-time database to perform the desired function with the desired appliance.

II. LITERATURE SURVEY

A. IOT based Home Automation System using Raspberry-Pi

Availability of high-speed mobile networks like 3G, 4G and Long Term Evolution coupled with cheaper and accessible smart phones, mobile industry has seen a tremendous growth in terms of providing various services and applications at the fingertips of the citizens. This paper discusses about IoT and it can be used for realizing smart home automation using Raspberry Pi. This system consists of a smart phone along with webpage, which is having the home appliance details with ON and OFF conditions. Smart phone is connecting with Raspberry Pi using the IP address of Raspberry Pi through Wi-Fi. The wireless application is user friendly improves efficiency and lifestyle. The system successfully overcomes the drawbacks in Bluetooth and ZIGBEE technology. Internet of Things (IoT) is one of the promising technologies, which can be used for connecting, controlling and managing intelligent objects, which are connected to Internet through an IP address.

B. Voice Recognition Based Home Automation using Raspberry Pi

Voice Based Home Automation System using Raspberry Pi is the project which will be very useful for old agepeople and disabled people, basically for one's who cannot perform basic activities efficiently. It is the idea, which corresponds to the new era of automation and technology. The main aim of the home automation system is to make life easier. Mobile devices are very common among everyone due to its user-friendly interface and portability features. In this project we aim to control electrical home appliances by android voice commands using Wi-Fi as communication protocol between Raspberry Pi and Android device. Raspberry Pi 3 becomes a better option for home automation via internet due to its feature of inbuilt Wi-Fi and Bluetooth.

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C. An IoT-Based Smart Home Automation System

Home automation has achieved a lot of popularity in recent years, as day-to-day life is getting simpler due to the rapid growth of technology. Almost everything has become digitalized and automatic. In this paper, a system for interconnecting sensors, actuators, and other data sources with the purpose of multiple home automations is proposed. The system is called qToggle and works by leveraging the power of a flexible and powerful Application Programming Interface (API), which represents the foundation of a simple and common communication source.

III. HARDWARE COMPONENTS

A. Motion sensor (PIR)

The PIR sensors are used to detect motion whether a human has moved in or out of the sensor's range. They arecost effective, low power, easy to use, and long lasting. For this reason, they are used in home appliances and gadgets orin businesses for security purposes.



Fig.1 Motion sensor

B. Ethernet Cable

The most common type of network cable for connection is Ethernet Cable used on a wired network at home or in any otherbusiness establishment. It connects wired gadgets together to the local network for sharing files and Internet access**.**

C. Relay Circuit Board

Relays are simple switches that can be controlled both electrically and mechanically. It is an electrically controllable switchused in industrial controls, automobiles, and appliances. It isolates two separate sections of a system with two different voltage sources. The relay circuit board consumes 12V.

D. Temperature Sensor

The DHT22 is used to measure temperature and humidity. A capacitive humidity sensor and a thermoresistor are used to measure the temperature and humidity of surrounding air, and send out a digital signal on the data pin. It is simple to use but requires time to grab data.

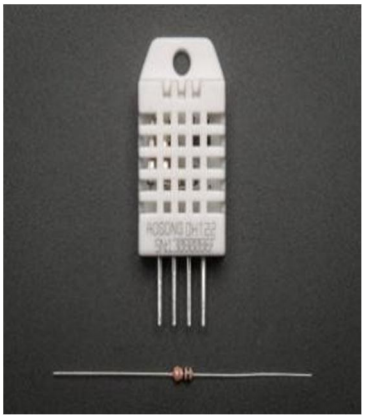


Fig.2 DHT22 Temperature and Humidity sensor

E. Gas Sensor

The MQ2 gas sensor is the most effective and sensitive gas sensor. The detection of gasses is done by changing the resistance of the sensing material when the gas comes in contact with the material, so the Metal Oxide Semiconductor (MOS) type Gas Sensor is also known as Chemiresistors. LPG, Smoke, Alcohol, Propane, Hydrogen, Methane, and Carbon Monoxide concentrations can be detected anywhere from 200 to 10000pp.



Fig.3 MQ-2 Gas Sensor

F. Buzzer

Buzzer is a device that creates sound signals reciprocal to electrical signals. A buzzer is a mechanical, electromechanical, magnetic, electromagnetic, electro-acoustic, or piezoelectric audio signaling device.



Fig.4 Buzzer

G. Raspberry–pi

The Raspberry Pi is a cost and size effective computer that plugs into a computer monitor or TV. It enables people to explore computing, and to learn how to program in languages like Scratch and Python also browsing the internet and playing high-definition video, making spreadsheets, word-processing and playing games**.**



Fig.5 Raspberry-Pi

H. Camera Module

The raspberry-pi Camera Module can be used to take high-definition videos and photographs popularly used in home security applications, and in wildlife camera traps. The camera works with all models of Raspberry Pi. It can be accessed through the MMAL and V4L APIs, etc.



Fig.6 Raspberry-Pi Camera Module

VI. SOFTWARE COMPONENTS

A. Raspbian OS

The operating system for the Raspberry Pi hardware is Raspbian, which is a set of basic programs and utilities that make the Raspberry Pi run. Raspberry Pi OS is specially developed for the Raspberry Pi and runs on every RaspberryPi except the Pico microcontroller.

B. Google assistant API

The Google Assistant Service exposes a low level API that lets you directly manipulate the audio bytes of an Assistantrequest and response. The Google Assistant SDK lets you add voice control, natural language understanding and Google's smarts to your ideas.

C. Firebase

The Firebase Real-time Database is a cloud-hosted database that stores the data as JSON and synchronizes it in real-time to every connected user. When we need to build cross-platform apps with iOS, Android, and JavaScript SDKs, all of the users shall share one Real-time Database instance and automatically receive updates with the newest data.

D. Dialogflow

Dialogflow is a platform that is used to develop a communicating interface for the system and user. It takes both text/ audio as input from the user and also responses back either through text or with synthetic speech.

E. Firebase Cloud Messaging

Firebase Cloud Messaging (FCM) is a platform for messaging solutions that lets us send messages efficiently.
FCM lets us send push notifications, interacting via the database

VII. METHODOLOGY

A. Google Assistant API and Dialogflow

The command is received by R-pi through Google assistant (both text and voice commands). The system is initiated by installing a Google API on raspberry pi. For setting up the Google Assistant on the R-pi we first install the python virtual environment on the R-pi and download its dependencies. Then we set up the Python3 version for our usage. The second step is to install the Google Assistant SDK via the R-pi command line. After getting the newest version of the Google Assistant SDK we enter our credentials and set it up. We then link the credentials with the Google Permission Page and run the Google Assistant. The R-pi recognizes the command specified by the user and sends the response tothe Google server. The command is then redirected to the GPIO ports of the raspberry pi to activate the relay. After activation, the relay, which is been connected to the home appliances can be controlled by user command. For Setting up Google Assistant app in Actions on Google console and Dialogflow agent we have to create the project under Dialogflow and link the agent with the actions on Google project. Lastly, we add the app information which includes a suitable name and some sample invocations which tell the user how our app will be invoked by the Google Assistant. After all the information is added, the app is completed in actions on Google Console, with all the required details. We open the Dialogflow console and select our agent. Then import all the needed data for our agent training and working, in the form of Intents and Entities. The Dialogflow agent is now ready to accept our requests and respond to them.

B. Firebase CLI

After, creating the agent, we link the project to the real-time database. Then, installing the firebase tools using NPM, authenticate firebase tools by signing in with the same email used in actions on the google app. We install actions on theGoogle nodejs client library. The code for the webhook goes in index.js. When the code for the webhook is ready, we deploy the cloud function. Once the deployment is complete, a link is generated which acts as our webhook HTTP endpoint. Now configure web credentials with FCM and generate a new key pair through the Firebase console, which will subscribe the app to push notifications. Using FCM, we are sending a notification message to users when the app is in the background on the device. After obtaining the token (An ID issued by the GCM connection servers to the client app that allows it to receive messages), we send it to the app server and store it. In the case of image notification, the image is been uploaded to the firebase and the cloud function triggers a notification.

C. Working of sensors

1) *Sending gas leakage alert via firebase:* The MQ2 gas sensor will detect any trigger of the raspberry-pi, which will then send the information to firebase and firebase will send a notification alert to google assistant.
2) *Intruder detection using motion sensor:* When any person arrives near the entrance, PIR sensor will detect any presence and the camera module will capture the image and send it to firebase. After which a push notification willbe sent to google assistant to let the user knows about the intruder.
3) *Temperature and humidity sensor:* Detects the temperature and humidity in the room, uploads the data in the firebase and sends to the user whenever the user requests it.

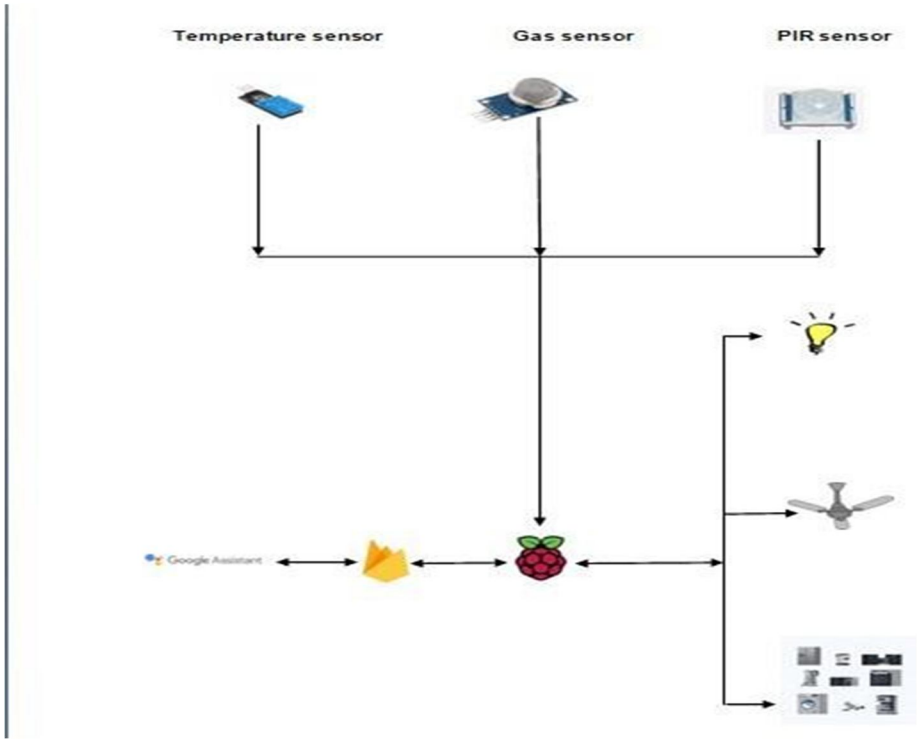


Fig.7 Schematic Diagram of the proposed system

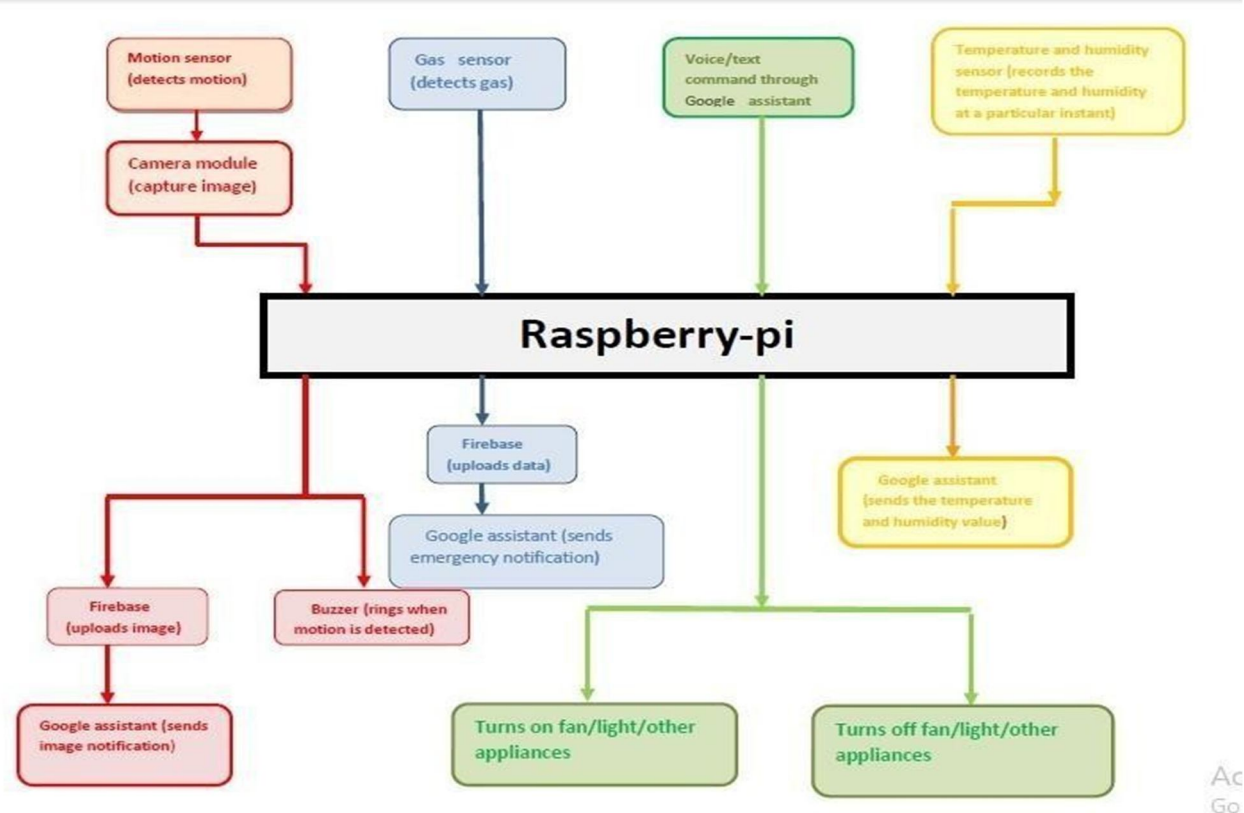


Fig.8 Flowchart of the smart home automation system

VIII. CONCLUSION & FUTURE SCOPE

This type of home automation systems are essential in the situation when human forgot to turn off the home appliances in order to conserve energy. We can easily control appliances through our smartphones and unnecessary electricity bills can also be avoided for the same. The future of Home Automation System is very vast. As per requirement, there can be many functionalities, which we can come up with.

Some features are mentioned below:

1) User can add new appliances in the agent.

2) We can use TensorFlow to get more accurate results for intruder detection purpose.

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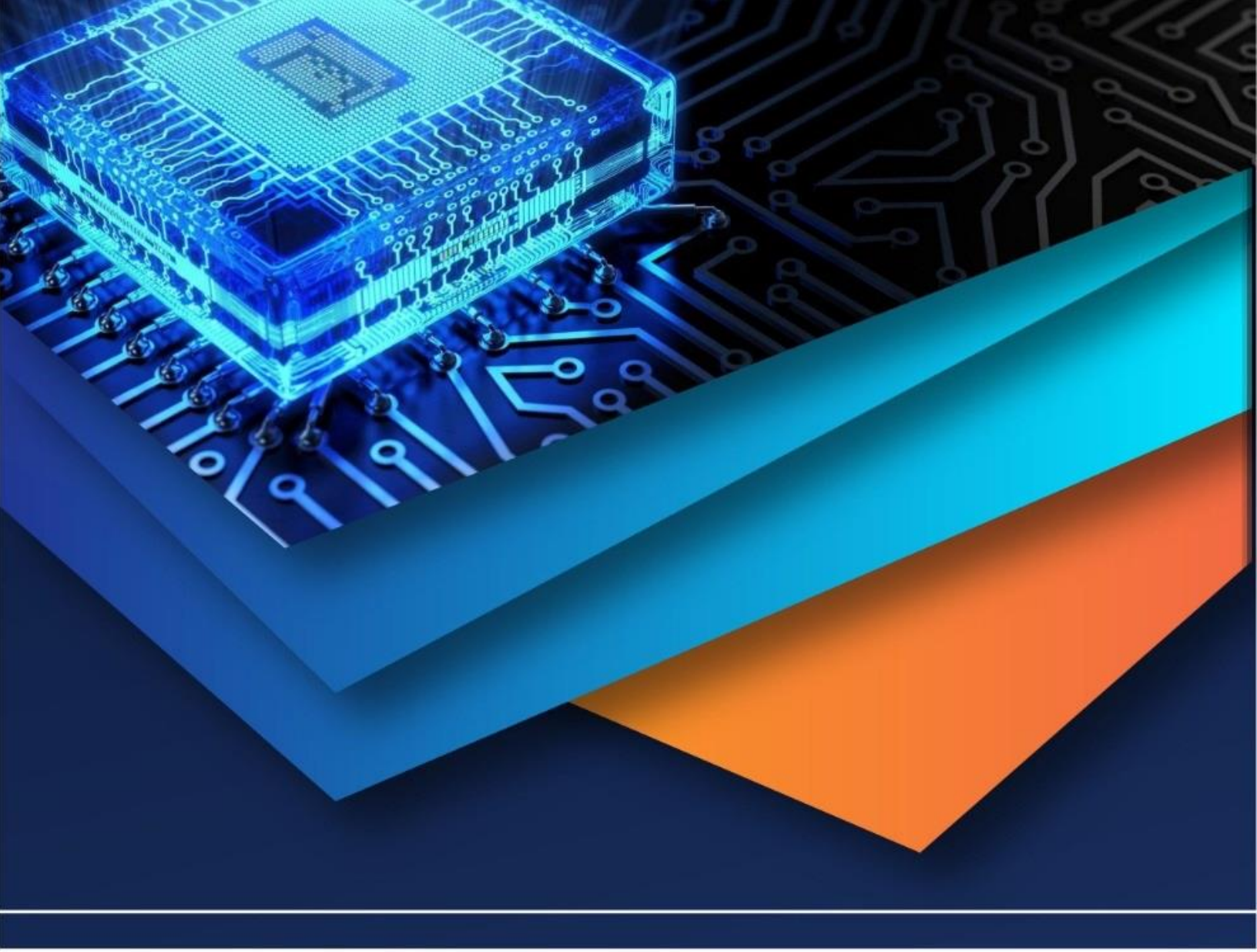
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