

IoT BASED COST EFFECTIVE HOME AUTOMATION AND SECURITY SYSTEM

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Abstract—Nowadays role of intelligent machines in our life is very valuable. With the advancement of digital technologies like IoT and machine learning many embedded systems are developed for various applications. Even in homes also, people are depending on machines to finish many tasks of order small to critical activities like cleaning, washing to security. Hence in this work concentration is paid on the design and development of low cost, reliable solution useful for both in home automation and security by using the Node MCU and Google Assistant. This system can monitor and control various parameters like temperature, humidity, light intensity. It can detect the fire, motion and also provides the security to home with the help of automatic door locking system. It will take the vocal commands from the google assistant and data from the sensors and are analysed in the cloud server IFTTT. Based on the derived decision corresponding control action will be initiated to adjust the physical parameters and restores the required environment.

Keywords—Node MCU, Home automation, IoT, Google Assistant, Adafruit IO.

I. INTRODUCTION

Home automation systems also known as Domotics, play an important role in this era make the people comfort in their busy daily routine life. Home automation system is a technological solution to automate the electrical and electronic appliances present at the home. There exists both software and hardware technological solutions to control and manage the home appliances. The benefits of home automation systems are: Smart thermostats and smart bulbs save energy by reducing utility costs over time by 10% to 25%. Smart water monitoring systems control water consumption, and also save water bills. Smart television,

music players and air-conditioning systems give lot of comfort their due to programmable remote operation. Many home automation technologies used for security can close smart garage doors, turn off lights or lock smart locks whenever person left the home. Even with the help of smart apps people can control the home appliances remotely as per their requirement. Home automation solutions are eco-friendly can reduce the heat and energy consumption by automatically put off the appliances when they are not in use.

At present, usage of electrical and electronic appliances has increased, which simultaneously enhances power consumption. In the year 2019, India occupied 3rd position globally by generating 1,347 TWh of power. Gradually power generation from non-renewable sources was diminishing. Hence there is a need to reduce the wastage of electricity by using it reliably. This can be achieved by connecting the things using IoT technology. IoT is the Union of People, process, Network and connectivity. In this each device is assigned with an Internet Protocol (IP) address and connected to the internet so that anyone can identify that device. This research concentrates on proposal of home automation system using IoT. The proposed system has features like fire detection helpful to prevent the fire accidents, door locking etc. By using the vocal commands through google assistant and the user interface application Adafruit IO, one can operate the fans, lights, door lock remotely. This system uses Wi-Fi for the internet connectivity between Node-MCU and the cloud server IFTTT.

This paper was organized as follows. Section.I deals with the introduction to the security systems and their importance at present scenario. Section.II discusses about

some of the existing systems. Section.III describes the proposed system whereas Section.IV explains the implementation of the proposed system. Section.V covers the results and finally concludes the work.

II. RELATED WORKS

Javvaji. et.al. [1] implemented a prototype of automated Polyhouse system using Arduino mega and ESP8266 module. It can control Gas, light and temperature automatically. S. Hidayat, S. F. Firmanda. [2] designed a home automation system using raspberry pi. This prototype can control the lamps in the home using vocal commands. S. Hidayat, S. F. Firmanda. [3] have implemented a home automation system based on Zigbee and iOS, it can control the temperature and lights. R. K. Koda, S. Yerroju. [4] proposed a system uses ESP8266 and Tinger IO as the user interface, it can control a 4 plugged switch board remotely using internet and the web application. H. K. Singh, S. Verma, S. Pal and K. Pandey. [5] designed a home automation system uses ESP8266 along with the relays connected to a switch board and control it remotely using internet. H. Singh, V. Pallagani, V. Khandelwal and U. Venkanna. [6] proposed a IoT based home automation system using the Arduino UNO and ESP8266 which can control the fans and lights inside the home using the web application. S. Dey, A. Roy and S. Das. [7] have proposed a design using the raspberry pi connected with the Wi-Fi router, this gives an idea how the web system can connect to the home through the internet. [14,9,8,12,15,10] in these works' authors used Node MCU or Arduino micro controllers for controlling the fans and lights remotely. [13,11,16] In these works' authors concentrated on proposal of designs for automatic control of two or three appliances inside the home. Few realized solutions are dedicated only for the monitoring of the gas level inside the home. All the previous works deals only home automation, this work includes both the automation and security in a cost effective way.

III. PROPOSED METHODOLOGY

In this paper, home automation system was proposed which controls the on and off states of lights, fans, water taps and the door lock system automatically with the help of voice commands through google assistant. Parameters like motion, fire, temperature and humidity can also be detected by using corresponding sensors. The block diagram of proposed home automation system is shown in Fig.1.It consists of all the sensors and their respective actuators, power supply board connected to the CPU (Node MCU)

board using the GPIO pins. Node MCU is connected to internet via Wi-Fi. Google Assistant is connected to IFTTT cloud server and the Adafruit IO. IFTTT is a cloud server which acts as a bridge between the Google assistant and the Adafruit IO which is a user interface application all the sensor and actuator data is displayed in this application. The sensor DHT11 is used to measure temperature and humidity. Whenever the temperature and humidity values exceed the threshold values, it will alert the user via Adafruit IO. Depending on the situation the user can put on the fans by sending the voice commands to google assistant. Fire sensor() is used to detect the fire in the home, it will alert the user by enabling the alarm and also send alert using the Adafruit application. Light intensity sensor() is used to control the light intensity will alert the user with the help of Adafruit IO whenever it is below the threshold value. Motion detection sensor is used to detect the moving object. If any moving object is sensed it will send the alert to user through IFTTT and Adafruit IO. Automatic door lock system is used to lock and unlock the door remotely using the Adafruit. Here all the communication is happening through the MQTT protocol.

1. Node MCU: Is a microcontroller and heart of the system. All the sensors and actuators are directly connected to it. It has inbuilt ESP8266 Wi-Fi module.
2. Temperature and Humidity Sensor: DHT11 is an ultra-low cost and basic digital sensor used to detect the both temperature and humidity. In this system threshold value is set to 25 if it exceeds this notification is send to user and user can operate the fans in the home using google assistant.
3. Fire Sensor: RKI-3100 is a flame detecting sensor, it is a digital sensor which detects flame light in the range of 760-1100nm and its detection angle is about 60°. whenever fire is detected alarm will be ring in the home and alert will be sent to user through internet.
4. Light Sensor: TSL2561 is the light intensity sensor used to detect the light intensity. Threshold values is set to 45 when the light is below 45 the reading will be displayed in Adafruit application so that user can operate the lights using Adafruit IO.
5. Motion Detection Sensor: PIR sensor HC-SR501 is a motion detection sensor used for the security purposes. It works on 5v DC voltage within the range of 20 feet. Whenever the motion is detected Node MCU will send the alert to user.

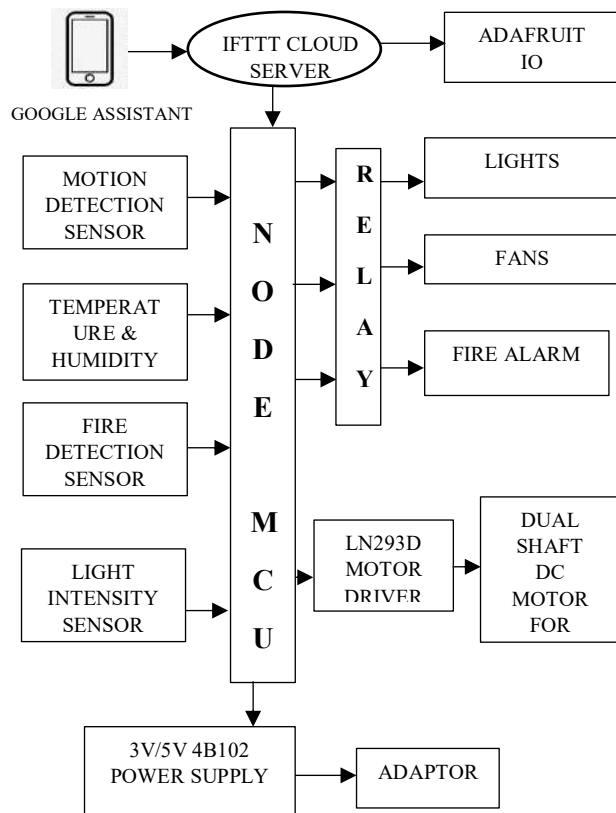


Fig.1. Block diagram of the Proposed Home Automation System.

6. Automatic Door Lock System: Dual shaft DC motor is used to lock or unlock the door. Whenever the user needs to open or close the door user can operate with the use of Adafruit application without using the Key.
7. IFTTT: “IF This Then That” is a cloud server acts as a bridge between the Adafruit IO and Google Assistant.
8. Adafruit IO: It is the user interface application uses the MQTT protocol. It will display the status of all the sensors and actuators to the user through internet.

IV. IMPLEMENTATION

The proposed system monitors temperature, lightening, gas, motion and security is implemented by generating code in the Arduino IDE and dumped into the Node MCU. Fig.2(a) represents the smart light which automatically on when the light intensity below the set threshold value. Fig.2(b)

represents the smart fan when temperature exceeds the set threshold. Likewise, other options are provided to monitor the gas leakage, automatic door locking system based on the person's movement will ensure the safety and security of the home.

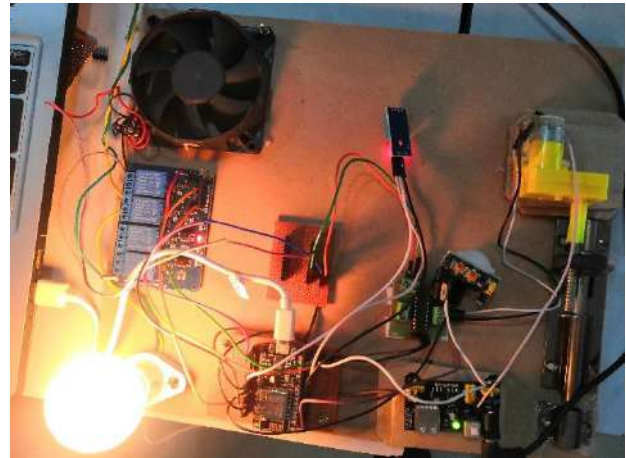


Fig.2(a). Automatic glowing of light

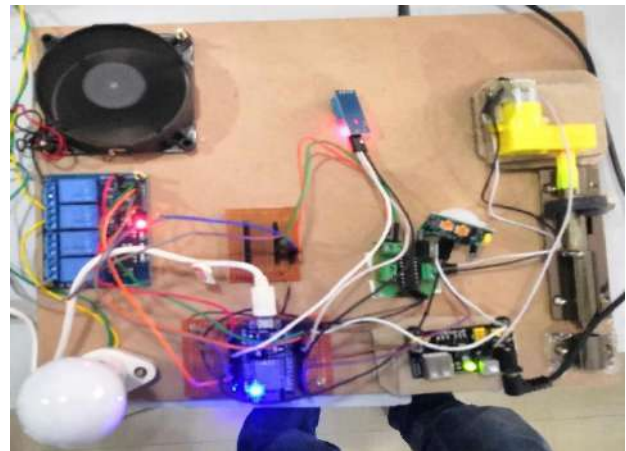


Fig.2(b). Automatic Rotation of fan

A) ALGORITHM

Initialize all the sensors and also configure Wi-Fi

i)Configure Wi-Fi (PW / Username), IFTTT Server and Adafruit_MQTT AIO_KEY, Google Assistant

ii) **Define NodeMCU.GPIO** for Relay board // For switching actuators like fan, door lock, buzzer, lights and appliances

iii) **Define NodeMCU.GPIO_sensors** // For getting the sensors data
 Temp \leftarrow Temperature value, Fire \leftarrow Fire value,
 Hum \leftarrow Humidity value
 Set threshold values for sensor values: Temp_TH, L_TH, Fire_TH, Hum_TH

Data Acquisition from sensors

```
{
do
  Get Temp, L, Hum, Fire, Motion
  Upload data to Adafruit MQTT Server through Wi-Fi
  Update the status of actuators/sensors in Adafruit MQTT Server
{
Case i (DHT_11)
  if (Temp >= Temp_TH || Hum >= Hum_TH) then
    turn ON fan
    Notify user via IFTTT "Temp./Hum. are High!"
else
  turn OFF fan
  break;
Case ii (light)
  if (L >= L_TH) then
    turn ON lights
else
  turn OFF lights
  break;
Case iii (motion sensor)
  if Motion is detected then
    Notify the user through IFTTT "motion detected at entrance!"
  break;
Case iv (gas)
  if (Fire >= Fire_TH) then
    Notify user via IFTTT "Fire alert"
  break;
}
```

Control Actions:

User can monitor all sensors data and actuator status remotely with help of Adafruit IO

User can control appliances through Google Assistant/Adafruit IO remotely

```
}
```

V. RESULTS AND CONCLUSIONS

A. RESULTS

Home automation and security system was implemented using Arduino controller and IDE and the results are observed through notifications using Google Assistant and mobile app. Fig.3 shows the IFTTT applet where notifications can be observed by providing voice commands to google assistant. As shown in Fig.4. the Adafruit IO user interface which displays the sensor and actuators values and user can operate the actuators with the help of Adafruit IO here the actuators are in inactive/off position. Fig.5 shows the Adafruit interface where the actuators status was indicated.

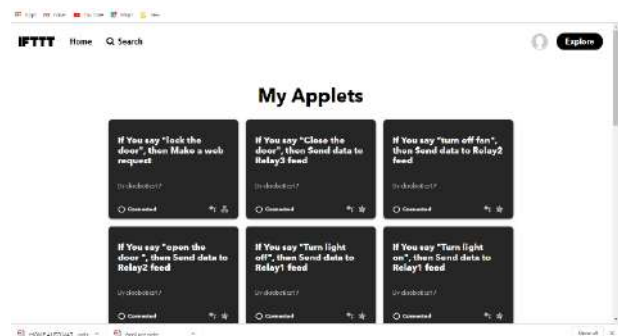


Fig.3. IFTTT Applet web page



Fig.4. Actuators are Inactive/off position in Adafruit IO

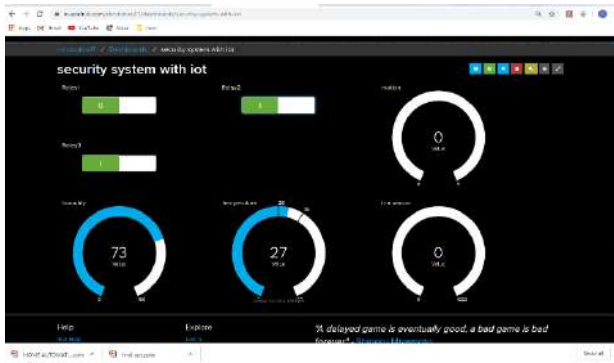


Fig.5. Actuators are active/on position in Adafruit IO

B. CONCLUSIONS

Node-MCU based automated smart home security system was implemented using Arduino IDE. This can be used to control the electrical appliances such as light, fan, gas, temp, door lock etc. The measurements of sensors and actuators are read from webpage. The system is a cost effective one, portable, reliable and user friendly. This is more useful for smart buildings and smart villages. The proposed system saves the resources and also reduces the heat generation. It also ensures the security and safety of homes.

C. FUTURE SCOPE

This system can be made more capable / purposeful by the inclusion of camera which enhances control and monitoring actions such as remote monitoring and guidance of kids when the elders are away from the home. By the use of high-end CPU, data can be continuously stored and predictions can be derived and better decisions can be arrived.

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