Third International Conference on "Materials, Computing and Communication Technologies"
International Journal of Scientific Research in Computer Science,
Engineering and Information Technology | ISSN : 2456-3307 (www.ijsrcseit.com)

An IoT Based Secure Smart Home Automation Using Cross Layer Optimization

S. Vishnupriya[1], J. Jayasree[1], R. Aarthi[2]
[1]UG Student, [2]Assistant Professor
Department of Electronics and Communication Engineering, RAAK College of Engineering and Technology, Pondicherry, Tamil Nadu, India

Article Info
Volume 8, Issue 7
Page Number : 81-90

Publication Issue :
May-June-2022

Article History
Accepted: 01 June 2022
Published: 20 June 2022

ABSTRACT

Home automation is a famous and most useful technology in the world, with the help of Automation technology, life is getting simpler and easier in all aspects. In today's world Automatic systems are being preferred over manual system. In this method different hardware/sensor devices maintain more security and safety to the smart home. In this paper a Wireless Home Automation system (WHAS) using cloud networking, wireless communication, to provide the user with remote control of various lights, fans and electronics appliances in the home and storing the data in the cloud. Our system is designed to be used in home for monitoring various parameters such as temperature, gas, vibration and intruder. The result being shown with the help of Raspberry Pi, when the parameters cross beyond the limit then alert can be sent to neighbours by buzzer. The sensor values are stored in IoT Cloud through internet. Internet is connected to the Raspberry Pi board, so using IP address user can monitor the house through camera from anywhere in the world. When any accidental action like gas leakage, smoke, breakage of windows, doors and any intruder in front of locker or wardroom, the alert send to user and then user login into the IoT cloud (adafruit.io) to view the activities of our house. The results are recorded using Raspberry Pi and the sensor values are displayed on an LCD display. The cloud data can be secured using cross layer optimization protocol. Cross Layer Optimization is protocol designed by crossing the two layer to protect the cloud data. The system automatically changes on the basis of sensors' data. This system is designed to be low cost and expandable allowing a variety of devices to be controlled.

Keywords: Wireless Home Automation System(WHAS),Cloud Networking, Alarm, Raspberry pi, Sensors, Camera, Cross Layer Optimization.

I. INTRODUCTION

Internet of Things (IoT) is a concept where each device is assigned to an IP address and through that IP address anyone makes that device identifiable on internet. The mechanical and digital machines are provided with unique identifiers (UIDs) and the ability to transfer data over a network without requiring human-to-human or human-to-computer interaction. Basically, it started as the "Internet of Computers." Research studies have forecast an explosive growth in the number of "things" or devices that will be connected to the Internet. The resulting network is called the "Internet of Things" (IoT).

The recent developments in technology which permit the use of wireless controlling environments like, Bluetooth and Wi-Fi that have enabled different devices to have capabilities of connecting with each other. Using a WIFI shield to act as a Micro web server for the Arduino which eliminates the need for wired connections between the Arduino board and computer which reduces cost and enables it to work as a standalone device. The Wi-Fi shield needs connection to the internet from a wireless router or wireless hotspot and this would act as the gateway for the Arduino to communicate with the internet. With this in mind, an internet-based home automation system for remote control and observing the status of home appliances is designed. Due to the advancement of wireless technology, there are several different types of connections are introduced such as GSM and WIFI. Each of the connection has their own unique specifications and applications. Among the four popular wireless connections that often implemented in HAS project, WIFI is being chosen with its suitable capability. The capabilities of WIFI are more than enough to be implemented in the design. Also, most of the current laptop/notebook or Smartphone come with built-in WIFI adapter. It will indirectly reduce the cost of this system. The concept of "Home Automation" has been in existence for several years. "Smart Home", "Intelligent Home" are terms that followed and is been used to introduce the concept of networking appliance within the house.

Home Automation Systems (HASs) includes centralized control and distance status monitoring of lighting, security systemand other appliances and systems within a house. HASs enables energy efficiency, improves the security systems, and certainly the comfort and ease of users. In the present emerging market, HASs is gaining popularity and has attracted the interests of many users. HASs comes with its own challenges. Mainly being, in the present day, end users especially elderly and disabled, even though hugely benefited, aren't seen to accept the system due to the complexity and cost factors.

II. PROPOSED METHOD

In this proposed system Raspberry Pi is used and internet connection is established for the purpose of automation using IoT by accessing the IP address. The LEDs are used in this system instead of connecting home appliances. Home automation system is used for controlling and continuously monitor the home appliances. In this system, concept of IoT is used in order to control the devices remotely from anywhere. Raspberry Pi is used as the board controller to connect the appliances via input and output port.

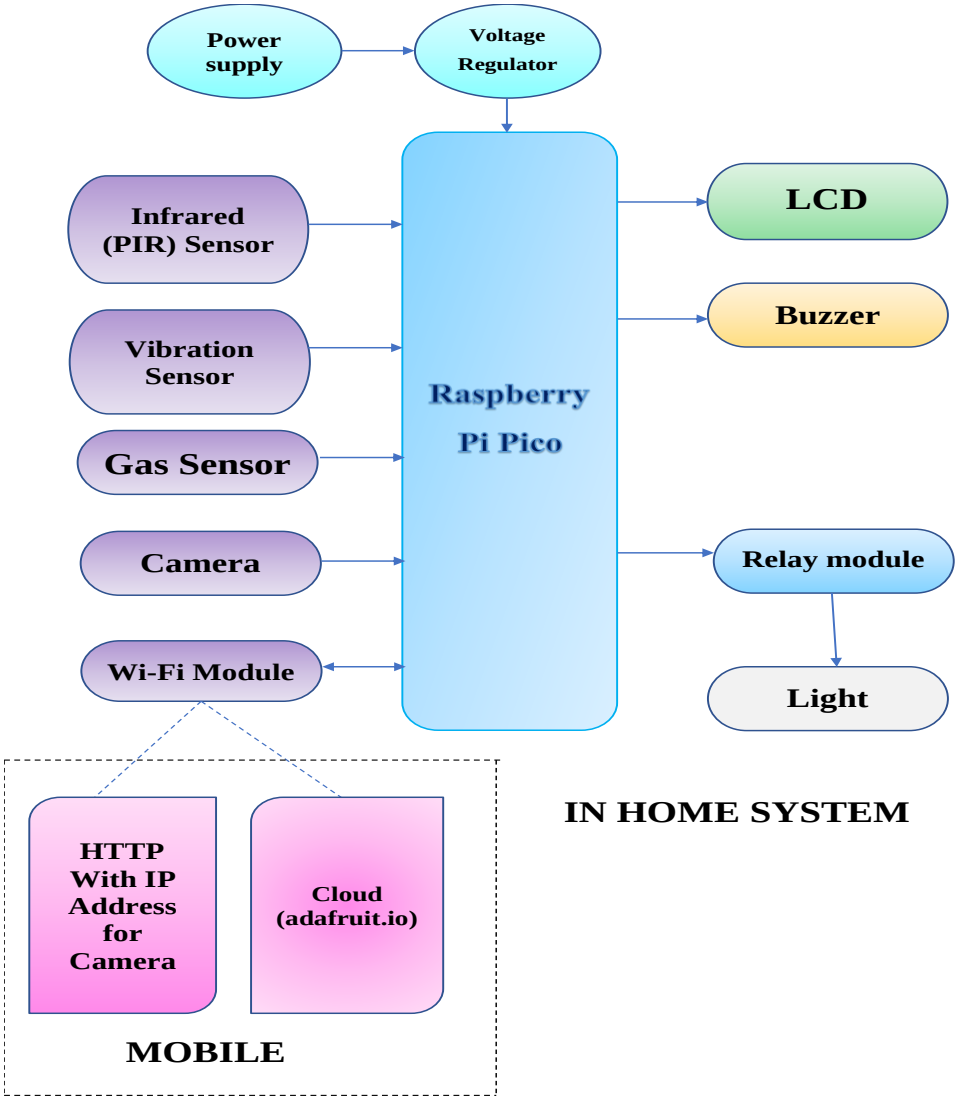

Fig 1: Block diagram Home Automation

Web interface (on Mobile phones, laptop, etc.) and Raspberry Pi are connected through internet. All the devices are connected with Raspberry Pi. Here two-way relay is used in order to connect bulbs. For the program to execute and work automatically according to the embedded program keep the Raspberry Pi online i.e., it should be connected to the Wi-Fi. In order to access the web interface from anywhere user need to provide IP address in the URL to open the webpage. On the webpage ON, OFF and regulation buttons are present. By using these buttons, they able to control the electrical home appliances which they connected with Raspberry Pi.

Apart from manual regulation of the device, they have embedded code in the Pi for automatic regulation such as detection of gas leakage using gas sensor, motion detection in front of locker or wardroom using PIR sensor, breakage detection in windows or door using vibration sensor. The sensors data are stored in Cloud. The separate IP address with HTTP provided for the camera. It is used to monitor the kids or old people inside house without any manual assistant.

III. IMPLEMENTATION METHODOLOGY

A. Hardware Description

This deals with the physical entities used in the system. The main part of the system is Raspberry Pi, which controls and monitors the overall behaviour of the system. The Hardware's are

1. Raspberry Pi
2. LM324
3. Temperature Sensor
4. Infrared Sensor
5. IoT Modem
6. Camera Esp32
7. Light Emitting Diode
8. Liquid Crystal Display

1. Raspberry Pi:

Raspberry Pi is open-source electronics prototyping platform based on flexible, easy to-use hardware and software. Raspberry Pi can sense the environment by receiving input from a variety of sensors and can affect its surroundings by controlling lights, motors and other actuators.

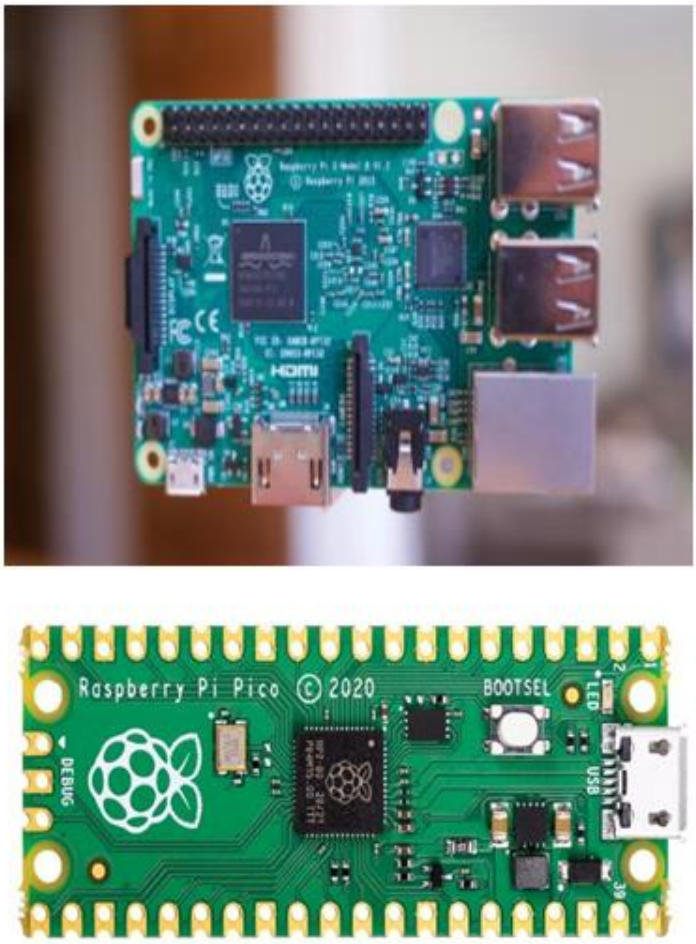

Fig 2: Raspberry Pi Pico

The Raspberry Pi Pico is a small, fast and versatile board that is equipped with the RP2040 microcontroller chip developed by the Raspberry Pi Foundation. RP2040 microcontroller chip on board. The RP2040 has a 133 MHz

synchronized dual-core arm Cortex-M0+ processor with integrated 2 MB QSPI flash memory for code and data storage. A wide range of flexible I/O options include I2C, SPI and uniquely Programmable I/O (PIO).

2. LM324:

Since the output voltage from voltage divider varies with the intensity of IR light and microcontroller is not used in this project, a comparator (LM324) is used to show the changes.

3. Temperature Sensor:

LM35 is a precession Integrated circuit Temperature sensor, whose output voltage varies, based on the temperature around it. It is a small and cheap IC which can be used to measure temperature anywhere between -55°C to 150°C.

4. PIR Sensor:

PIR Sensor detects animal/human movement in a requirement range. PIR is made of a pyroelectric sensor, which is able to detect different levels of infrared radiation. The detector itself does not emit any energy but passively receives it. It detects infrared radiation from the environment. Once there is infrared radiation from thehuman body particle with temperature, focusing on the optical system causes the pyroelectric device to generate a sudden electrical signal.

5. IoT Module:

The physical interface to the mobile application is made through a 60 pins board-to board connector, which provides all hardware interfaces between the module and customers' boards except the RF antenna interface.The keypad and SPI LCD interface will give the flexibility to develop customized applications. Two serial ports can help you easily develop applications.Two audio channels include two microphones' inputs and two speaker outputs. This can be easily configured by AT command.

6. Camera ESP32-CAM:

The ESP32-CAM is a small size, low power consumption camera module based on ESP32. It comes with an OV2640 camera and provides onboard TF card slot. The ESP32-CAM can be widely used in intelligent IoT applications such as wireless video monitoring, Wi-Fi image upload, QR identification and so on.

7. Light Emitting Diode:

A light-emitting diode (LED) is a semiconductor light source. LEDs are used as indicator lamps in many devices, and are increasingly used for lighting. Colour of the light (corresponding to the energy of the photon) is determined by the energy gap of the semiconductor. An LED is often small in area (less than 1 mm2), and integrated optical components may be used to shape its radiation pattern. LEDs present many advantages over incandescent light sources including lower energy consumption, longer lifetime, improved robustness, smaller size, faster switching, and greater durability and reliability. LEDs powerful enough for room lighting are relatively expensive and require more precise current and heat management than compact fluorescent lamp sources of comparable output.

8. Liquid Crystal Display:

LCD (Liquid Crystal Display) is a type of flat panel display which uses liquid crystals in its primary form of operation. Liquid Crystal Display (LCD), electronic display device that operates by applying a varying electric voltage to a layer of liquid crystal, thereby inducing changes in its optical properties. In this project lcd is used to display the alert intimation as output.

B. Software Description

1. Python:

Python is an interpreted, interactive, object-oriented programming language. It incorporates modules, exceptions, dynamic typing, very high-level dynamic data types, and classes. It supports multiple programming paradigms beyond object-oriented programming, such as procedural and functional programming. Adding a program to Pico is as easy as dragging and dropping a file while Raspberry Pi Pico is in boot mode. Micro Python is an implementation of the python programming language that is already popular among Raspberry pi users. MicroPython is built specifically for microcontrollers like the Rp2040 that powers Raspberry Pi Pico, MicroPython offers the same friendly syntax as python, it allows for full control over Raspberry Pi Pico's various features, including its Programmable Input/Output(PIO) functionality.

2. Adafruit.com:

Adafruit.com was developed in 1969 to aid in remote connectivity between computers over a network.The purpose of the ADAFRUIT.COM Protocol is to provide a fairly general, bi-directional, eight-bit byte-oriented communications facility. Its primary goal is to allow a standard method of interfacing terminal devices and terminal-oriented processes to each other. It is envisioned that the protocol may also be used for terminal-terminal communication and process-process communication (distributed computation).

3. Cross Layer Optimization:

Cross Layer Optimization removes such strict boundaries to allow communication between layers by permitting one layer to access the data of another layer to exchange information and enable interaction. In this project cross of two layers Application layer and Physical layer. If login id matches to that it allows user to login to cloud(adafruit.io). If the layer in off state it never accepts the data and does not allow to login.

IV. EXPERIMENTAL RESULT

The Fig.3 shows the Hardware working module. It consists of Raspberry Pi Pico board, Temperature sensor, Gas sensor, vibration sensor, PIR sensor and LCD Display.

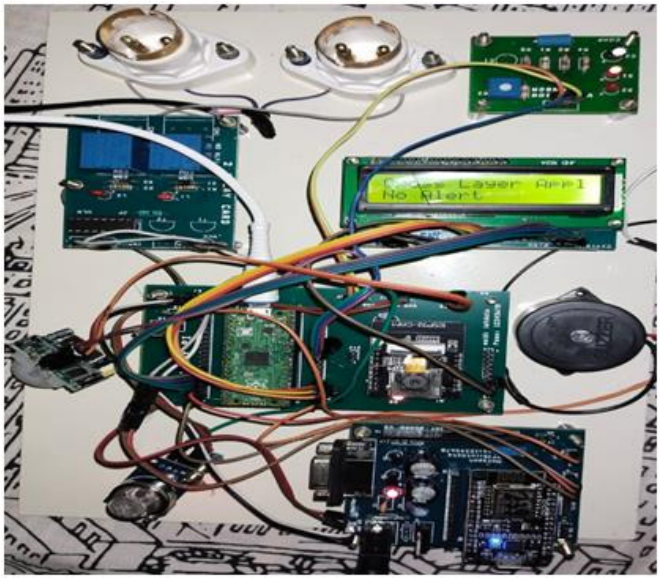

Fig 3: Hardware Working Module

V. SIMULATION AND HARWARE RESULT

TURN OFF THE HOME APPLIANCES

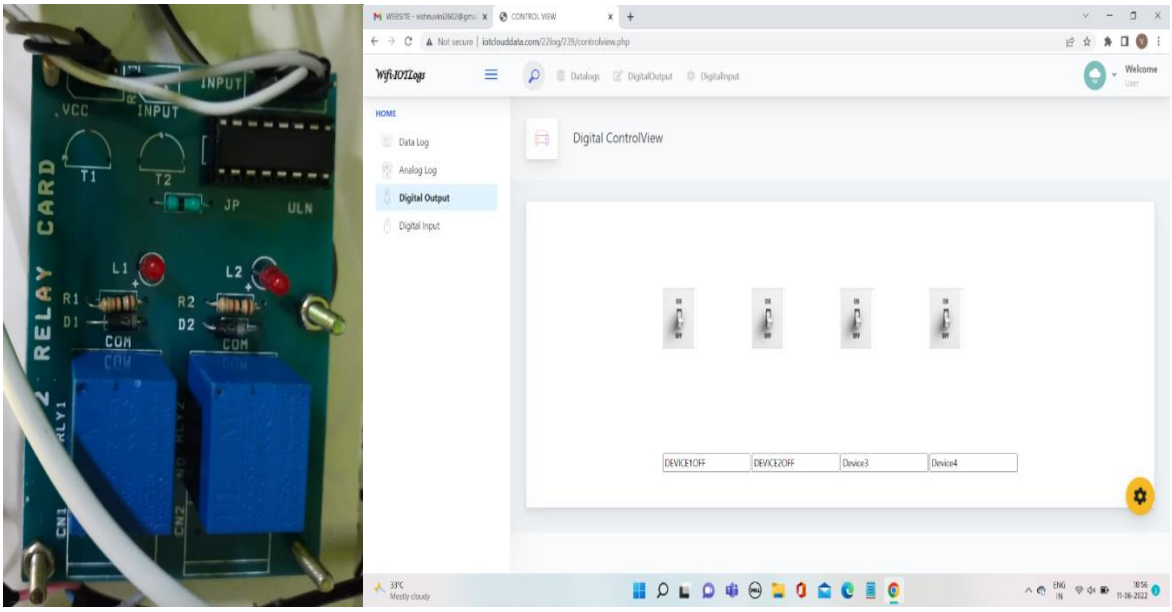

Fig 4a: OFF State of LED

TURN ON THE HOME APPLIANCES

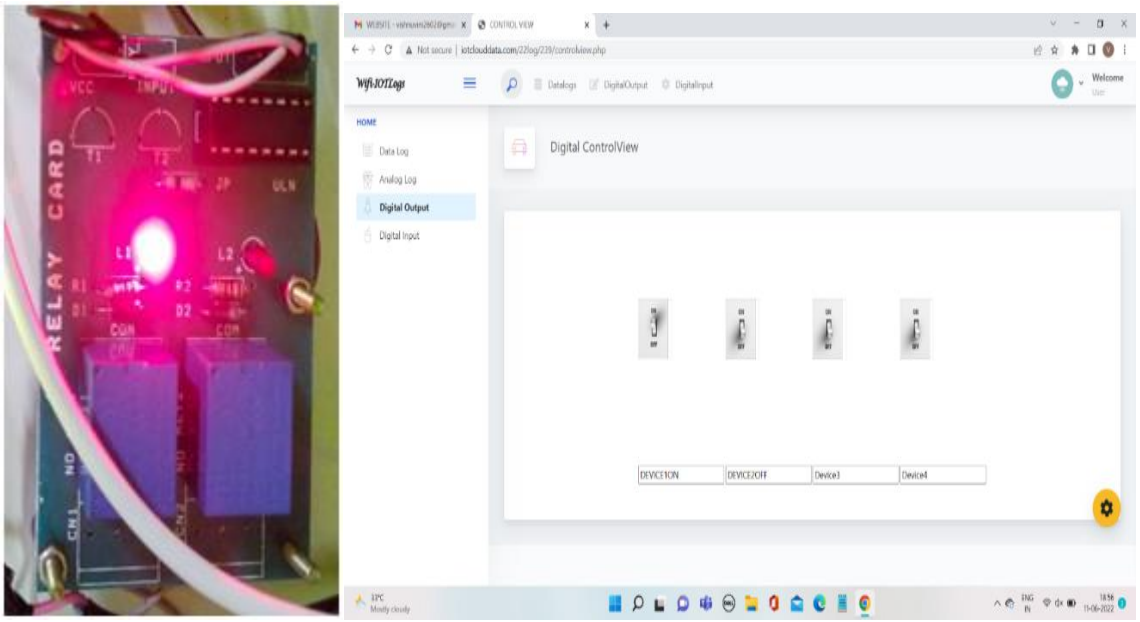

Fig 4b: ON State of LED

The Fig. 5 show that if there is no changes in sensor value the Raspberry Pi sends the no alert to the adafruit.io (Cloud) continously when device on. The no alert message are displayed in LCD and Cloud.

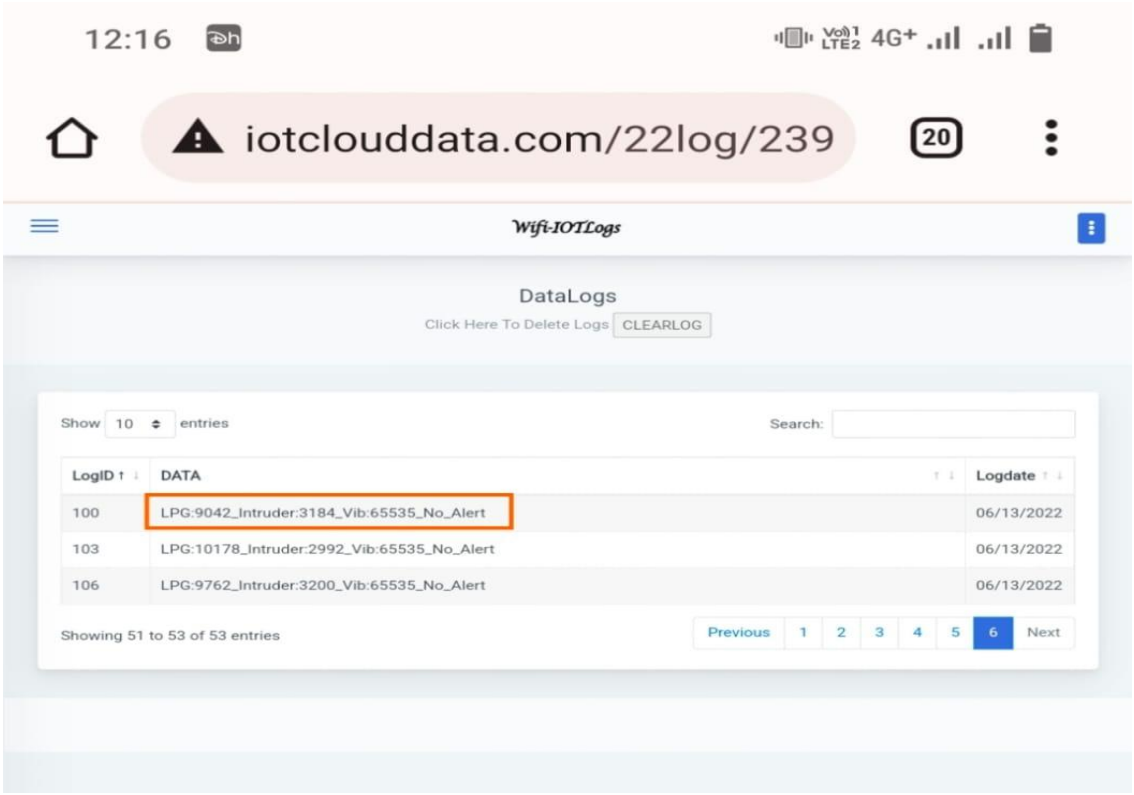

Fig 5: Result of no alert in Cloud

The Fig. 6 show that if there is changes in PIR sensor value the Raspberry Pi sends the Intruder alert to the adafruit.io (Cloud)when any person comes infront of locker or wardroom. The Intruder alert message are displayed in LCD and Cloud. Intimate the neighbours through the buzzer.

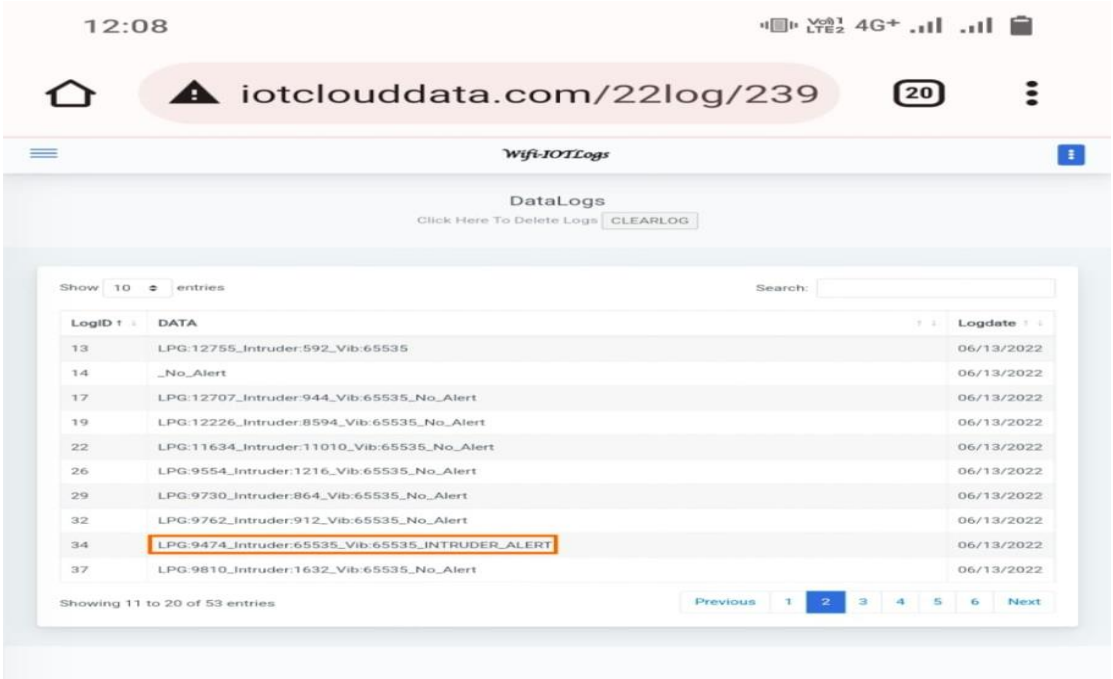

Fig 6: Result of Intruder alert in Cloud

The Fig. 7 show that if there is changes in Gas sensor value the Raspberry Pi sends the LPG Leak alert to the adafruit.io (Cloud) when gas leakage inside house. The LPG Leak alert message are displayed in LCD and Cloud. Intimate the neighbours through the buzzer.

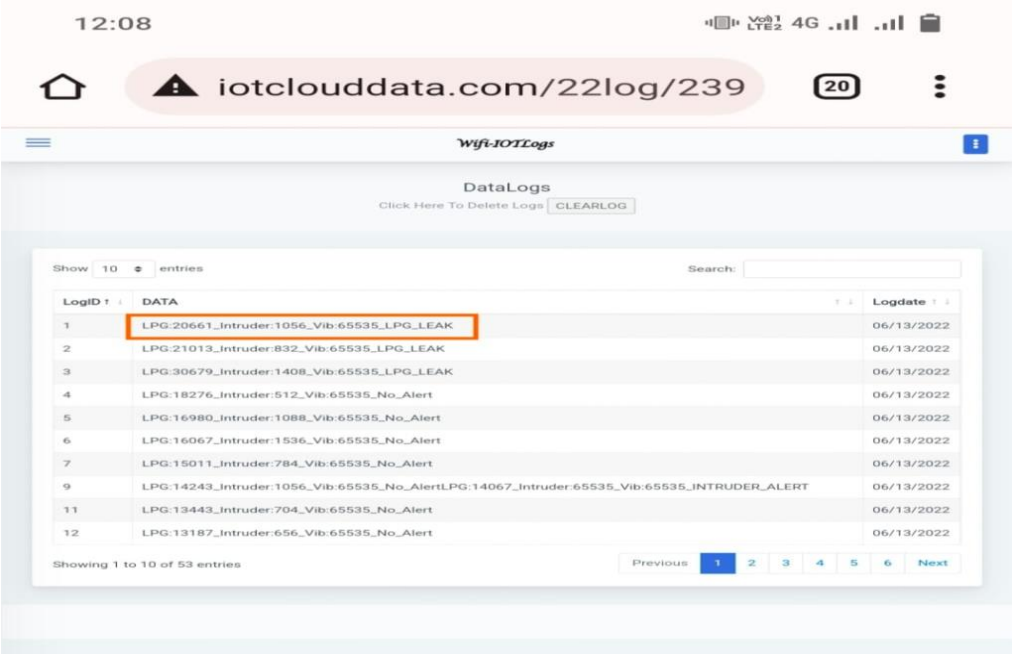

Fig 7: Result of LPG Leak alert in Cloud

The Fig. 8 show that if there is changes in vibration sensor value the Raspberry Pi sends the Window break alert to the adafruit.io (Cloud)when any person breaks the window or door. The Window break alert message are displayed in LCD and Cloud. Intimate the neighbours through the buzzer.

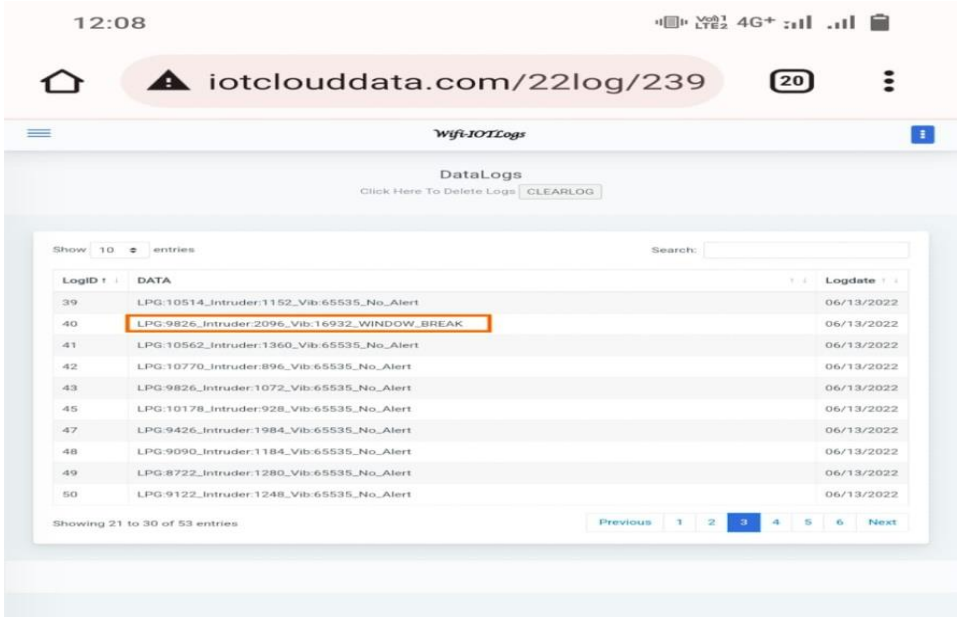

Fig 8: Result of Window break alert in Cloud

The Fig. 9 show that if there is changes in Multiple sensors value the Raspberry Pi sends the Multiple alert to the adafruit.io (Cloud). The Multiple alert message are displayed in LCD and Cloud. Intimate the neighbours through the buzzer.

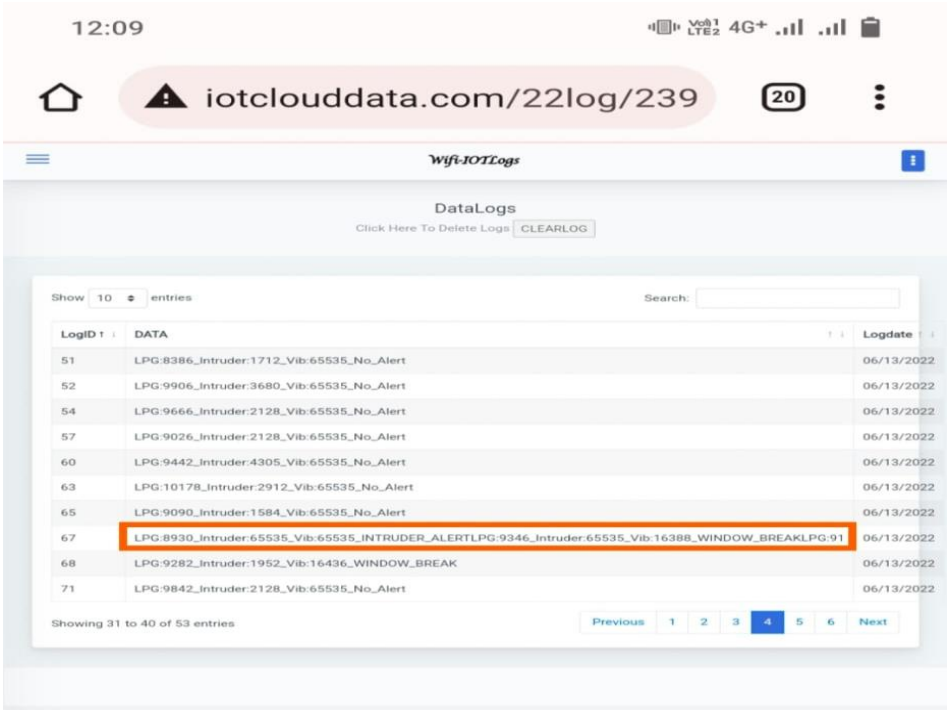

Fig 9: Result of Multiple alert in Cloud

The Fig. 10 show thatcontinuously monitoring the housemates via camera.

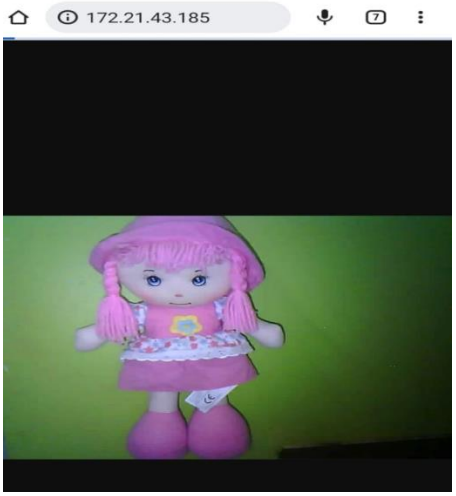

Fig 10: Camera view inside house

VI. CONCLUSION

This project is developed for house to maintain security and also monitor our kids and grandparents without any assistance in our house through camera. If any unwanted action happens then the buzzer gets on and intimated to the user and neighbours. This project is developed for Houses, small, large, medium size nationalmultinational organizations which keeps large amount of money in their office and want 100% security. Their main requirements where they wanted a system that could alert them when burglary takes place at the time when office is closed. These organizations are very big and have many employeesmost of the employees do overtime and stay at office for late nights. Supervisor is responsible to switch off the electric lights, other appliances and lock the office after everyone leaves but the main problem was this supervisor had

to stay with employees for long time until they finish their work, so we proposed this system to these organizations that can solve out their problems. Now supervisor can monitor the employees from their houses using live web cams, turn off lights and doors when everyone is gone.

VII. REFERENCES

[1]. Hongwei Luo, Chao Wang, Hao Luo, Fan Zhang, Feng Lin, Guoai Xu, "G2F: A Secure User Authentication for Rapid Smart Home IoT Management", in 2020.

[2]. Y. Liu, C. R. Taylor, and C. A. Shue, "Authenticating endpoints and vetting connections in residential networks," in 2019 International Conference on Computing, Networking and Communications (ICNC). IEEE, 2019, pp. 136–140.

[3]. A. Wang, A. Mohaisen and S. Chen, "XLF: A Cross-layer Framework to Secure the Internet of Things (IoT)," 2019 IEEE 39th International Conference on Distributed Computing Systems (ICDCS), 2019, pp. 1830-1839, doi: 10.1109/ICDCS.2019.00181.

[4]. M. Bettayeb, Q. Nasir, and M. A. Talib, "Firmware update attacks and security for iot devices: Survey," in Proceedings of the ArabWIC 6th Annual International Conference Research Track, ser. ArabWIC 2019. New York, NY, USA: ACM, 2019, pp. 4:1–4:6. [Online]. http://doi.acm.org/10.1145/3333165.3333169

[5]. M. Hasan, P. Biswas, M. T. I. Bilash, and M. A. Z. Dipto, "Smart home systems: Overview and comparative analysis," in 2018 Fourth ICRCICN. IEEE, 2018, pp. 264–268.

[6]. Surinder Kaur, Rashmi Singh, Neha Khairwal and Partyk Jain, "Home Automation and Security System" in Advanced Computational Intelligence: An International Journal (ACII), Vol.3, No.3, July 2016.

[7]. Pooja Patel, Mitesh Patel, Vishwa Panchal and Vinit Nirmal, "Home Automation using Internet of Things" in Imperial Journal of Interdisciplinary Research (IJIR), Vol-2, Issue- 5, 2016.

[8]. Pooja N. Pawar, Shruti Ramachandran, Nisha P. Singh and Varsha V. Wagh, "A Survey on Internet of Things Based on Home Automation" in International Journal of Innovative Research in Computer and Communication Engineering, Vol2, Issue-1, January 2016.

[9]. Aarti and Pooja Mittal, "Review Paper on Home Automation Using Internet of Things" in International Journal of Emerging Trends & Technology in Computer Science (IJETTCS), Vol-5, Issue-4, July - August 2016.

[10]. A. Dmitrienko, C. Liebchen, C. Rossow, and A.-R. Sadeghi, "On the (in) security of mobile two-factor authentication," in International Conference on Financial Cryptography and Data Security. Springer, 2014, pp. 365–382.