ISSN (Online): 2583-7052

International Journal of Advanced Trends in Engineering and Management (IJATEM)
Vol. 2(04), April 2023, pp. 36-45

Article Title: Design and Implementation of IoT Based Smart Home Automation System and Control Electrical Appliances Using Blynk App

Design and Implementation of IoT Based Smart Home Automation System and Control Electrical Appliances Using Blynk App

R. Siva Nagini

Assistant Professor, Department of Electrical and Electronics Engineering, Universal College of Engineering and Technology, Vallioor, Tamilnadu, India. sivanagini23.abt@gmail.com

ABSTRACT

A Node MCU ESP8266 is used in this project to propose an Internet of Things (IoT)-based smart home automation and monitoring system. Safety should be a top priority for any activity done within the residence. Gas leaks, uncontrolled flames, hot temperatures and wet surroundings must all be found and dealt with as quickly as feasible. Apart from that, it's also important to monitor and manage electrical devices like lights, refrigerators, ovens, etc. The primary goal of this article is to create a functional prototype of a smart home powered by Internet of Things. Several sensors, relays and a Node MCU ESP8266 Board are used in the system. With a DHT11 Sensor, the home's temperature and humidity are tracked. With the help of a MQ-135 Gas Sensor, the Air Quality Index (Gas) is monitored. The Blynk application tracks all sensor data. Home appliances are controlled by a command sent through Blynk App. As the gas level exceeds, the exhaust fan operates and the alarm goes off. A PIR sensor is used to determine whether someone is in or out of the house. Through Blynk App, a user can remotely turn on and off electrical equipment.

Key Words: DHT11 Sensor, MQ-135 Gas Sensor, Node MCU ESP8266, PIR Sensor.

1 Introduction

The Internet of Things paradigm embraces the notion that physical object related devices are always online, able to transmit data and capable of acting in the real world [1]. IoT applications are not only applicable in one industry. Small scale applications, such as those in E-commerce, coal mines, wearable technology, the smart grid, laboratory monitoring, agriculture and many other disciplines, have been shown to make a significant contribution to large scale applications [2]. In the modern day, smart home automation is a crucial IoT application feature. It minimises human labour while enhancing comfort and convenience [3]. By merging sensors, actuators and metering devices as well as supporting other network activities and system automation, Internet of Things (IoT) technology is crucial in helping the smart grid achieve its monitoring, safety, and control goals [4]. Home automation components used to be pricey, had non-standard interfaces and were therefore separate parts that couldn't communicate and work

ISSN (Online): 2583-7052

International Journal of Advanced Trends in Engineering and Management (IJATEM)
Vol. 2(04), April 2023, pp. 36-45

with other parts of the house [5]. Wireless sensor/actor networks and a range of ubiquitous computer devices are expertly combined to create a modern smart home [6]. The devices in a room can be controlled by someone using a household electrical appliance control system [7]. The use of WiFi to minimise installation is the main emphasis of this research, and a created prototype can be used to control and monitor home appliances in real time [8]. Monitoring unexpected behaviours always calls for complex techniques [9]. To achieve personal constraint optimisation through planning, which also addresses over constraint scenarios, this study uses weighted constraint satisfaction problem (CSP) for human centric smart homes [10].

2 Recent Works

Jabbar et al [2019] proposes a cost effective and user friendly hybrid IoT based home automation system with a pleasant interface for smartphones and computers. To enable remote monitoring of home conditions and automated operation of home appliances, a prototype named IoT@HoMe is being created. In order to monitor and manage a real home, the system that was developed was built to be transportable. IoT@HoMe is a low-cost, dependable automation solution that aids residents of SH in energy conservation and may even improve convenience, security and safety. [11]

Zungeru et al [2019] Create and build a secure wireless and self-energy harvesting switching system for smart homes. An effort is being undertaken to create a secure smart home switching system that combines access control for the electrical supply of a building with energy harvesting and storage for active electronic components and circuitries, wireless communication for smart switches and plugs and active electronic component and circuitry storage. The proposed system employs a solar system with an energy buffer of ultra-capacitors to collect and store energy for all active electronic components. The secure smart home's architecture made it simple to regulate energy use by utilising smart switches, power and messaging queuing telemetry transport (MQTT). [12]

Logenthiran et al [2019] developed a system for detecting energy theft called the Smart Energy Theft System (SETS) that is based on statistical modelling and machine learning. Smart meter and the Internet of Things (IoT) have taken the role of traditional analogue metres within a modern smart home. It digitalizes data collection and metre readings. Nevertheless, energy theft can happen within smart home network's community. Due to the fact that the methods currently in use require specific devices to be installed in order to function, such attacks cannot be properly detected. Due to lack of energy monitoring technologies, it is difficult to implement energy theft detection systems. In order to predict power usage, this system combines different machine learning models into a single prediction system. Phase two is the main decision-making stage that employs Simple Moving Average (SMA) for abnormality detection. The

ISSN (Online): 2583-7052

International Journal of Advanced Trends in Engineering and Management (IJATEM)
Vol. 2(04), April 2023, pp. 36-45

third phase, which creates a final level of choice about energy theft, is the secondary decision making model. [13]

Iqbal et al [2021] examines how an ideal energy use solution might be modified to accommodate revolutionary change. The problem of an electric power shortage and emergencies brought on by a sudden electricity surge are addressed by a technique that is suggested. The suggested method automates the appliances primarily in three ways: locally, online and through apps. By turning on and off appliances manually or automatically as needed through web or apps, the strategy aids in energy conservation. Additionally, it manages emergency situations by assessing its load and carrying out smart switching, allowing devices to continue operating safely even in unusual circumstances like low or high voltages. [14]

Jayashree Katti et al [2021] demonstrates how a camera could be used to communicate with a hand gesture system. The main objective is to simplify and ease human life. Electronic devices can be controlled with hand gestures. They can help with the creation of safe and welcoming user interfaces for a range of applications. The classification of movements from various people remains a challenge, despite the introduction of depth and colour cameras in numerous computer vision algorithms for hand gesture identification. [15]

3 Proposed Work

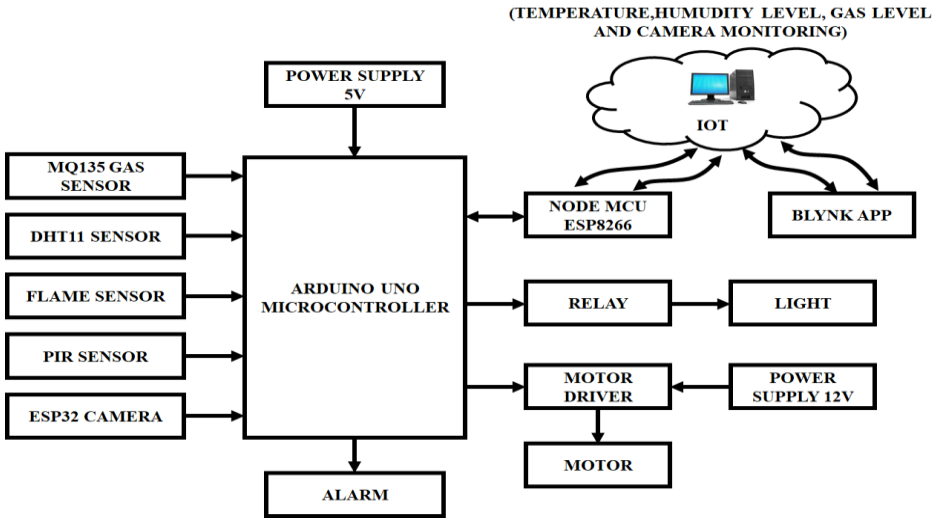

Figure 1: *Block Diagram of Proposed System*

An automated and monitored smart home system based on the Node MCU ESP8266 is proposed in this work. The proposed technology is created to immediately identify gas leaks, uncontrolled flames, high temperatures and wet situations. Remote control and monitoring of electrical appliances, such as lights, refrigerators and ovens, is also accessible. Several sensors, relays and a Node MCU ESP8266 Board are used in the system. Home temperature and

humidity are tracked using a DHT11 sensor and air quality index (gas) is tracked using a MQ 135 gas sensor. Each sensor's data is tracked using Blynk application. Home appliances are controlled by a command sent through Blynk App. The exhaust fan runs and the alarm goes off as soon as the gas level surpasses. To identify if someone is at home or not, a PIR sensor is employed. Users of a Blynk App can remotely turn ON and OFF electrical appliances.

3.1 Arduino Microcontroller

The widely used Arduino electronics platform is made up of open source hardware and software. Microcontroller is provided by a board built around the ATmega328 A 16 MHz ceramic resonator, six digital input/output pins, a USB port, a power jack, an ICSP header, and a reset button are all included. There are also six analogue inputs and a 16 MHz ceramic resonator. It already has everything needed to support the microcontroller; all you need to do to use it is add a USB cable, an AC to DC adapter or a battery for power.

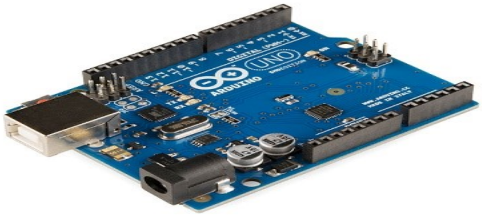

Figure 2: *Arduino Microcontroller*

3.2 Node MCU ESP8266

Plans for open source prototyping boards for the Node MCU's open source firmware already exist. The phrase "Node MCU" (micro-controller unit) is created by combining the terms "node" and "MCU". The ESP8266 WiFi Module, a self-contained SOC with an integrated TCP/IP protocol stack, enables any microcontroller to connect to a WiFi network. Along with hosting apps the ESP8266 has the ability to delegate all Wi-Fi networking tasks to a different application processor.

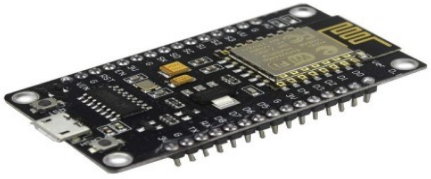

Figure 3: *Node MCU ESP8266*

ISSN (Online): 2583-7052

International Journal of Advanced Trends in Engineering and Management (IJATEM)
Vol. 2(04), April 2023, pp. 36-45

3.3 Gas Sensor

One of the most often utilised MQ sensor types is MQ2. A metal oxide semiconductor, or MOS, sensor, is what it is. Due to the fact that metal oxide sensors rely on a material's ability to change resistance when exposed to gases, they are sometimes referred to as chemiresistors. It is an adaptable sensor that can identify the levels of carbon monoxide, hydrogen, alcohol, smoke, LPG and smoke in air. It can also identify alcohol, propane and hydrogen. The MQ2 Gas Sensor Module is therefore an excellent choice for building a Breathalyser, an early fire detection system or a system to monitor indoor air quality.

Figure 4: *Gas Sensor*

3.4 Flame Sensor Module

The presence of a flame can be detected by a flame detector, which can then take action. These detectors can distinguish between smoke that won't spark a fire and smoke that will. These tools can also detect fire based on temperature and airflow. A flame sensor frequently reacts more quickly and accurately than a heat or smoke sensor because of the processes it employs to detect the flame. To check whether the furnaces are operating properly, flame sensors are typically utilised.

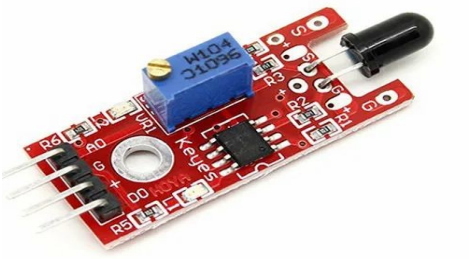

Figure 5: *Flame Sensor Module*

ISSN (Online): 2583-7052

International Journal of Advanced Trends in Engineering and Management (IJATEM)
Vol. 2(04), April 2023, pp. 36-45

3.5 DHT-11 Sensor

Temperature and humidity can be measured via the inexpensive digital sensor DHT11. For quick temperature and humidity monitoring, this sensor is easily connectable to any microcontroller including Arduino, Raspberry Pi, etc. The detection of temperature and humidity levels in HVAC systems is just one use for this sensor's many applications. The humidity sensor is used as a prophylactic measure in houses where residents are affected by humidity.

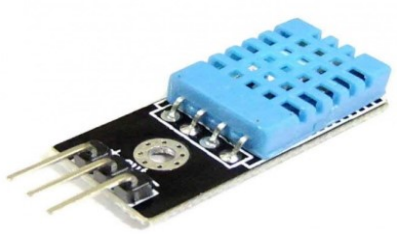

Figure 6: *DHT-11 Sensor*

3.6 PIR Sensor

Motion can be found using PIR sensors. When someone enters or leaves the sensor's range of view, they are used to determine it. They are typically seen in furnishings and technology utilised in homes and workplaces. Their primary application is in PIR based motion detectors. In autonomous lighting and security alarm systems, PIR sensors are frequently employed. Although PIR sensors can detect general movement, they cannot tell exactly who or what moved. Because they don't produce energy to detect objects, PIR devices are regarded as passive. They only use infrared radiation emitted or reflected from objects to function.

Figure 7: *PIR Sensor*

ISSN (Online): 2583-7052

International Journal of Advanced Trends in Engineering and Management (IJATEM)
Vol. 2(04), April 2023, pp. 36-45

3.7 ESP32 Camera

A compact camera module with an extremely low price, the ESP32 CAM Wi-Fi Module Bluetooth with OV2640 Camera Module 2MP For Face Reconstruction may run on their own as a minimum system with a footprint of only 40 x 27 mm; a deep sleep current of up to 6mA and is extensively utilised in many IoT applications. In order to facilitate quick product manufacture, this module uses a DIP package and may be installed immediately onto a backplane. It has on-chip sensors, Hall sensors, temperature sensors, and other sensors and is suitable for IoT applications such as wireless monitoring, industrial wireless control and residential smart devices.

Figure 8: *ESP32 Camera*

3.8 Relay Module

A relay is a switch that controls whether electricity flows through it. It can be turned on or off. Low voltages have the ability to operate relays. NC (Normally Closed): The generally closed option is used when the relay is to be closed by default, which means that current will flow unless a signal is delivered from the relay module to a relay to open the circuit and halt current. NO (Normally Open): The opposite is true for the normally open configuration.

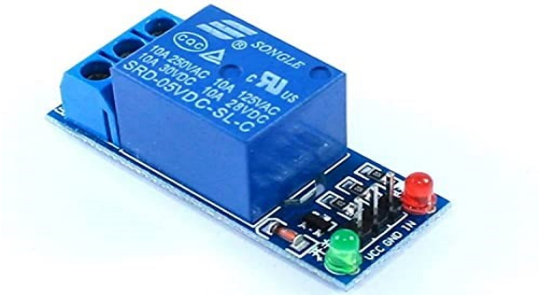

Figure 9: *Relay Module*

ISSN (Online): 2583-7052

International Journal of Advanced Trends in Engineering and Management (IJATEM)
Vol. 2(04), April 2023, pp. 36-45

3.9 Motor Driver

Depending on the voltage's polarity when it is applied, a motor will rotate either forward or backward. The voltage directly affects how fast the rotation spins. A rotor with a coil, a brush and a commutator make up its four main components. Motor drives for all electric motors are not readily available. For particular types of engines, several manufacturers create motor drivers. But, since motor drivers receive a list of all suitable motors from the manufacturers, it is made easier. When choosing a motor driver, a servo motor requires greater care.

3.10 Blynk App

Remote control of Arduino, Raspberry Pi, and Node MCU is made possible on iOS and Android mobile devices using the Internet of Things (IoT) platform Blynk. This application is used to create a graphical user interface (GUI) or human machine interface (HMI) by compiling and giving appropriate address on the widgets that are available. With the Blynk library, it is possible to directly control Arduino or ESP32 pins from a phone without writing any code. A project can also be shared with clients or friends, enabling them to access the connected devices but keeping them from making changes to project itself.

4 Result and Discussion

The prototype created in this study controls household items like an electrical bulb and fan. There has been given a design for a control system for home automation. This study primarily focuses on the use of Wi-Fi to minimise installation and a developed prototype can be applied to real time control of home appliances to monitor and remotely operate them.

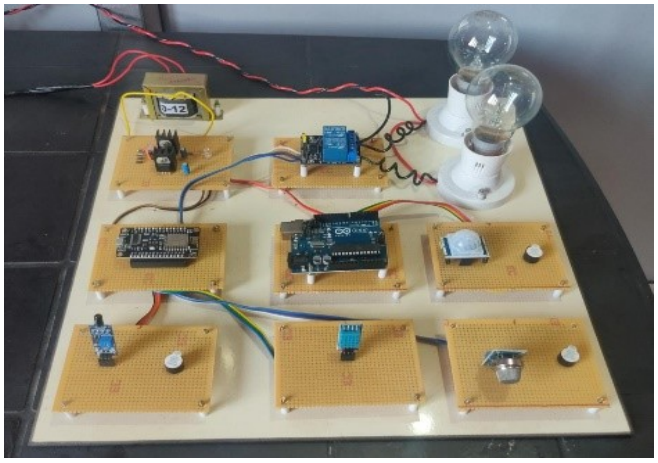

Figure 10: *Hardware Setup*

ISSN (Online): 2583-7052

International Journal of Advanced Trends in Engineering and Management (IJATEM)
Vol. 2(04), April 2023, pp. 36-45

Article Title: Design and Implementation of IoT Based Smart Home Automation System and Control Electrical Appliances Using Blynk App

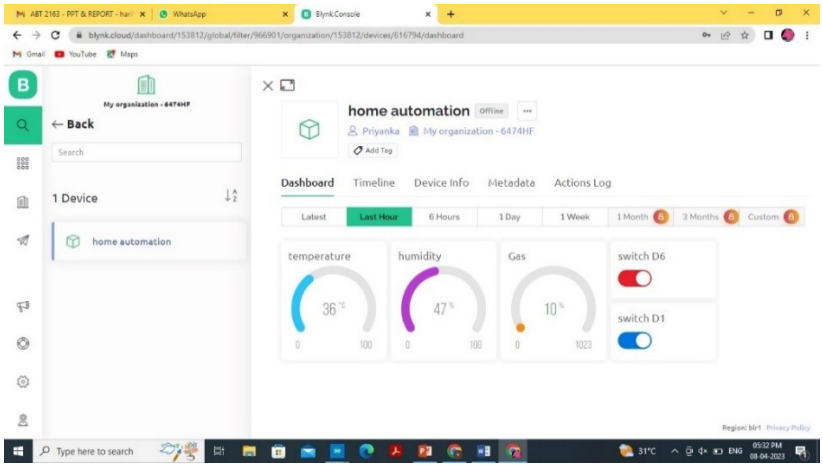

Figure 11: *Output Using Blynk App*

5 Conclusion

The convenience of home automation improves life. This paper used a Node MCU ESP8266 to demonstrate a smart home automation and monitoring system based on the Internet of Things. Uncontrolled fires, high temperatures and a damp environment are all quickly identified and dealt with. Moreover, electrical equipment like lights, freezers, ovens, etc. is monitored & regulated. The temperature and humidity in the house are monitored via a DHT11 sensor. Exhaust fan operation and alarm activation occur as the gas level reaches. The presence of a person at home is detected using a PIR sensor. All of the devices have sensors and are Wi-Fi connected, allowing users to control them from a smartphone or tablet from anywhere in the world, including their house. The user's information is tracked and updated through BLYNK app, a cloud based website.

References

1. Setz Brian; S. Graef; D. Ivanova, Year: 2021, A. Tiessen and M. Aiello, "A Comparison of Open Source Home Automation Systems," in IEEE Access, Vol: 9, pp. 167332-167352.

2. Vishwakarma Satyendra K; et al, Year: 2019, “Smart Energy Efficient Home Automation System Using IoT," 2019 4th International Conference on Internet of Things: Smart Innovation and Usages (IoT-SIU), Ghaziabad, India, pp. 1-4.

3. Chaurasia Tushar; Prashant Kumar Jain; Year: 2019, "Enhanced Smart Home Automation System based on Internet of Things," Third International conference on I-SMAC (IoT in Social, Mobile, Analytics and Cloud) (I-SMAC), Palladam, India, pp. 709-713.

4. Franco Patricia; José Manuel Martínez; Young-Chon Kim; Mohamed A. Ahmed, Year: 2021, "A

Framework for IoT Based Appliance Recognition in Smart Homes," in IEEE Access, Vol: 9, pp. 133940-133960.

5. Setz Brian; Sebastian Graef; Desislava Ivanova; Alexander Tiessen; Marco Aiello, Year: 2021, "A Comparison of Open-Source Home Automation Systems," in IEEE Access, Vol: 9, pp. 167332-167352.

6. Jose Arun Cyril; Reza Malekian, Year: 2017, "Improving Smart Home Security: Integrating Logical Sensing Into Smart Home," in IEEE Sensors Journal, Vol: 17, no: 13, pp. 4269-4286, 1 July1.

7. Novani Nefy Puteri; Mohammad Hafiz Hersyah; Ryon Hamdanu, Year: 2020, "Electrical Household Appliances Control using Voice Command Based on Microcontroller," 2020 International Conference on Information Technology Systems and Innovation (ICITSI), Bandung, Indonesia, pp. 288-293.

8. Graveto Vitor; Tiago Cruz; Paulo Simões, Year: 2023, "A Network Intrusion Detection System for Building Automation and Control Systems," in IEEE Access, Vol: 11, pp. 7968-7983.

9. Khan Murad; Junho Seo; Dongkyun Kim, Year: 2022, "Modeling of Intelligent Sensor Duty Cycling for Smart Home Automation," in IEEE Transactions on Automation Science and Engineering, Vol: 19, no: 3, pp. 2412-2421.

10. Tay Noel Nuo Wi; Janos Botzheim; Naoyuki Kubota, Year: 2018, "Human-Centric Automation and Optimization for Smart Homes," in IEEE Transactions on Automation Science and Engineering, Vol: 15, no: 4, pp. 1759-1771.

11. Jabbar Waheb A; et al., Year: 2019, "Design and Fabrication of Smart Home with Internet of Things Enabled Automation System," in IEEE Access, Vol: 7, pp. 144059-144074.

12. Zungeru Adamu Murtala; et al., Year: 2019, "A Secured Smart Home Switching System based on Wireless Communications and Self-Energy Harvesting," in IEEE Access, Vol: 7, pp. 25063-25085.

13. Li Weixian; Thillainathan Logenthiran; Van-Tung Phan; Wai Lok Woo., Year: 2019. "A Novel Smart Energy Theft System (SETS) for IoT-Based Smart Home," in IEEE Internet of Things Journal, Vol: 6, no: 3, pp. 5531-5539.

14. Iqbal Muhammad Javed; Muhammad Munwar Iqbal; Iftikhar Ahmad; Muneer Ahmad; N. Z. Jhanjhi; Sultan Aljahdali; Memoona Mushtaq, Year: 2021, "Smart Home Automation Using Intelligent Electricity Dispatch," in IEEE Access, Vol: 9, pp. 118077-118086.

15. Anitha E; et al., Year: 2021, “Face Recognition Based Secured Locker Control and Gesture Based Home Appliance Control for Disabled People”, International Research Journal of Engineering and Technology, International Research Journal of Engineering and Technology, Vol: 08, no: 05, pp. 1565-1570.