Smart Home Automation

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Abstract. In recent years, smart home automation has become attractive for improving homeowners' convenience, security, energy efficiency, and general quality of life. In this work, we design an overview of the main ideas, innovations, and advantages of smart home automation and the implementation of a NodeMCU microcontroller-based comprehensive home automation system. The system incorporates several sensors to monitor and manage home factors, including temperature, humidity, gas leak detection, flame detection, water tank levels, raindrop detection, home security, and electrical appliances. A centralized Blynk app is used for monitoring and control. The sensors are positioned strategically around the house and are connected to NodeMCU microcontrollers. A camera module is also used for security surveillance, and video recordings are sent to the cloud for remote access. The system functions by continually collecting sensor data, analyzing it with the help of NodeMCU modules, and delivering control choices and real-time updates through the Blynk app interface. Consequently, homes will benefit from increased convenience, security, and comfort.

Keywords: · IoT (Internet of Things) · Connected Devices · Smart Security · Cloud Integration · Mobile App Control · Home Monitoring · Smart Sensors.

1 Introduction

We give a synopsis of the issue and specify the specifications for our endeavor. We have created suggestions that direct the development and execution of our system based on an in-depth study and a literature review.

Home automation systems have grown in popularity with the introduction of Internet of Things (IoT) Technology to improve convenience, safety, and energy efficiency in homes. Our project aims to integrate several sensors with control systems to monitor and manage various aspects of the home environment, ultimately creating a complete home automation system. The NodeMCU microcontrollers, which are low-cost, low-power devices with Wi-Fi capabilities based on the ESP32 chipset, constitute the basis of the system[1]. By utilizing NodeMCU's features, we can create a flexible and scalable home automation system that is simple to modify to satisfy a range of requirements.[2].

Our home automation system integrates various sensors, including motion, light, humidity, and temperature sensors, to provide comprehensive monitoring capabilities. We can easily link these sensors to the internet by using the connection features of NodeMCU microcontrollers[3]. This allows for remote monitoring and control using an easy-to-use mobile application. This real-time data integration improves inhabitants' comfort and energy efficiency by optimizing household appliance performance. Additionally, our system's modular architecture simplifies future expansions and enables customers to add new features and devices as Technology develops and their needs change. Our goal with this project is to show how IoT technology can be used to build houses that are safer, smarter, and more efficient[4].

1.1 Literature survey

To improve convenience, safety, and security throughout the house, a range of sensors and modules are strategically positioned and integrated into the home automation system. The installation of gas and flame sensors in the kitchen room guarantees quick identification of possible gas leaks or fire breakouts, reducing hazards and protecting people from injury[5]. Comparably, adding the motion sensor and camera module to the front door offers more sophisticated security capabilities that let homeowners keep an eye on things and take action, including monitoring suspicious activity or unlawful access. When combined with the processing capability of the central hub, these sensors give consumers instantaneous information about the state of their homes and allow prompt action when needed[6].

Moreover, the central hub of the system serves as the brains, coordinating the exchange of information among sensor nodes and enabling a smooth integration with the Blynk mobile application. By utilizing WiFi connectivity, the central hub gathers data streams from various sensor nodes, analyzes the data, and uses the Blynk interface to provide users with actionable insights[7]. Homeowners may remotely regulate electrical appliances for maximum comfort and energy efficiency, monitor temperature and humidity levels, and receive warnings for unusual events like gas leaks or rains using the user-friendly smartphone interface. By combining sensor data with user-centric control mechanisms, homeowners can now see and manage their living spaces like never before, improving convenience and safety at the same time[8].

The main method by which homeowners communicate with the system is via the Blynk smartphone app. Users may remotely monitor and operate connected equipment from the comfort of their smartphones or tablets. Regardless of where they are physically located, homeowners have unparalleled control over their living environment, whether it is by changing the temperature, monitoring the level in the water tank, or shutting off lights[9].

Through camera modules, our system incorporates security surveillance capabilities in addition to sensor-based monitoring and appliance management[10]. These modules record video from important locations, including kitchens and entry doors, and then broadcast it to the cloud for remote access and storage. In addition to improving home security, this gives homeowners peace of mind because they can keep an eye on their property in real time and examine recorded footage as needed. Thanks to its scalability, versatility, and focus on comfort, security, and safety, our home automation system is a major step forward in modern home management[11].

2 Methodology

2.1 Functional Block Daigram

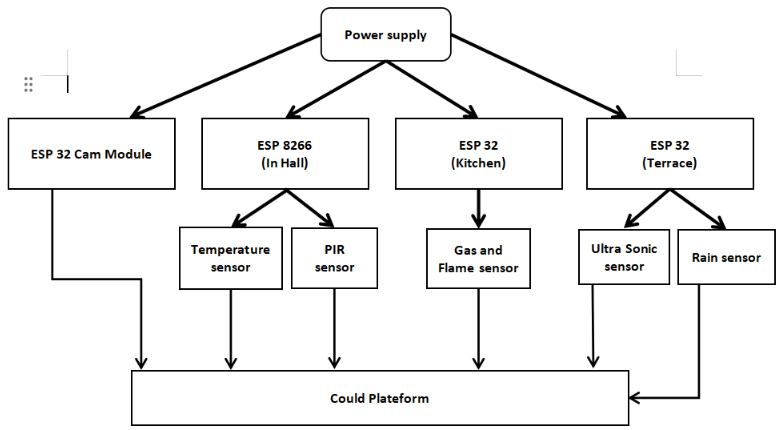

Fig. 1. Block Diagram

Figure 1 shows the functional block diagram:

1)Power Supply: The power supply provides power to every component of the system.

2)Gathering Sensor Data: The sensors gather information from their surroundings:
Temperature sensor: measures the Hall's temperature.
Hall motion is detected by the PIR sensor.
Flame and Gas Sensor: Identify any flames or gas leaks in the kitchen.
Using an ultrasonic sensor, you can measure the water level.
Rain sensor: recognizes rainfall on the terrace

3) Transferring Data to the ESP32 Camera Module: The ESP 32 Cam Module gathers data from its surroundings and transmits it to the cloud.

4) Remote Monitoring and Supervisors: A cloud platform or mobile app can be used to remotely monitor and control the system. Real-time seeing of the camera footage and sensor data is available to users. And, depending on sensor data, receive the alert signal.

2.2 Flow Chart

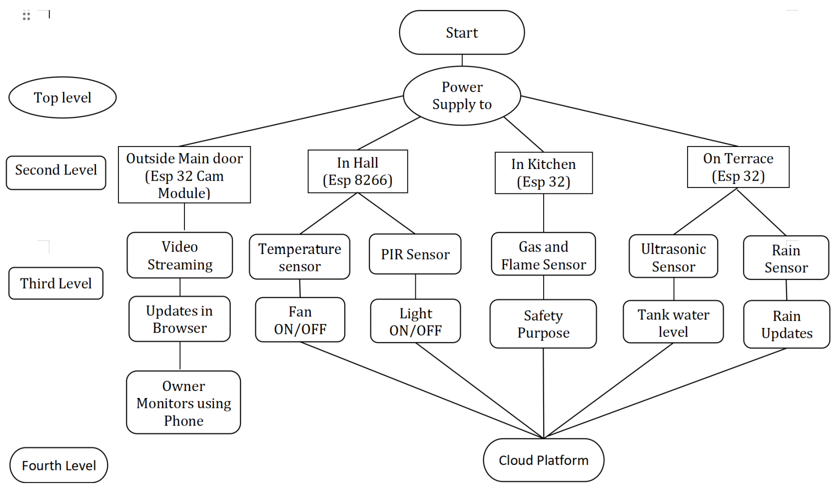

Fig. 2. Flow Chart

Figure 2 shows the flow chart. We employ two ESP modules in our home automation project to build a smart home environment: ESP32 and ESP8266. The system has various zones, including the area outside the main door, the hallway, the kitchen, and the terrace. Each zone is outfitted with particular sensors and modules connecting to a cloud monitoring and control platform. A central power supply provides power to the entire system.

Top Level:

Power Supply to Every ESP Module: Power Supply to Every ESP Module: this is the initial stage, supplying all ESP modules placed throughout the house with the necessary power.

Second and third level:

Outside Main Door (ESP32 Cam Module): Streaming Video: Recording footage from outside the main entrance.

Browser Updates: allows a web browser to receive the video feed in real-time for monitoring.

Owner Uses Phone to Monitor: enables the owner to use their phone to watch the video feed.

Owner Monitors through Phone: This feature enables the owner to watch the live video stream on their phone.

In Hall (ESP8266)

Temperature sensor: Determines the hall's temperature.

Fan ON/OFF: Utilizes temperature readings to control the fan.

PIR Sensor: Understands movement in the hallway.

Light ON/OFF: Uses motion detection to turn on and off the lights.

In Kitchen (ESP32)

Gas and flame sensors: monitor possible fire and gas leaks.

Safety Purpose: Guarantees safety by warning the owner in the event of a fire or gas leakage.

On Terrace (ESP32)

Ultrasonic Sensor: The tank's water level is measured by an ultrasonic sensor.

Tank Water Level: Refreshes the status of the water level.

Rain sensor: a rain detector. Rain Updates provides real-time rain detection updates.

Fourth Level:

Cloud Platform

The central location for integrating all of the devices and sensors. This makes it easier to monitor and manage the home automation system remotely. Provides notifications and alerts based on sensor readings and saves data for later analysis.

2.3 Algorithm

•Start

•Terrace:

Check the rain level using a rain level sensor. Check the tank level using an ultrasonic sensor. Send rain level and tank level data to the cloud using WiFi.

•Kitchen:

Implement smoke sensor and flame sensor. If the smoke threshold is exceeded, activate the buzzer. If the flame is detected, activate the alarm. Monitor smoke and flame values and send data to the cloud using Blynk.

•Bedroom:

Use a DHT11 sensor to sense temperature and humidity. If humidity rises above 85%, turn on the fan automatically using the relay.

•Security:

PIR sensor 1 overlooks the garden. PIR sensor 2 overlooks the backyard. If motion is detected by either PIR sensor, record the event and send data to the cloud. Activate alert system upon motion detection.

•ESP32-CAM:

Overlooks the front yard for security purposes. Monitor the cam continuously via the provided IP address. Provide multiple customization options for the cam.

•All sensors and devices are controlled by different microcontrollers. And the data is read and sent to the BLYNK cloud.

•End

3 Results and Discussion

3.1 Results

Tests were conducted on the ESP32 home automation system to assess its usability, performance, and dependability. Several domestic factors, such as temperature, humidity, gas leak detection, flame detection, water tank levels, rain level, home security, and electrical appliances, were all intended to be consolidated under the system's control and monitoring.

Fig. 3. Hardware setup

Fig 3 is the hardware setup of our system, where our home automation system uses three ESP32 microcontrollers for the kitchen, terrace, and camera module, and one ESP8266 for the hallway. Each of the microcontrollers is customized to meet the demands of the specific region it is installed in, and it is equipped with sensors. For centralized control, the microcontrollers use WiFi to connect to a central server and to each other. This configuration allows the system to be scalable and adaptable while guaranteeing effective administration of various regions. The values can be seen in the serial monitor as well as the IoT platform that is Blynk.

In Fig 4, 5, and 6, we use the Blynk platform in our home automation system to integrate all sensor data and control commands smoothly. The Blynk cloud server receives the sensor readings from each ESP32 and ESP8266 microcontroller, configured to deliver data on temperature, humidity, gas levels, motion detection, and other topics. All incoming data from the microcontrollers is received and stored by the Blynk cloud

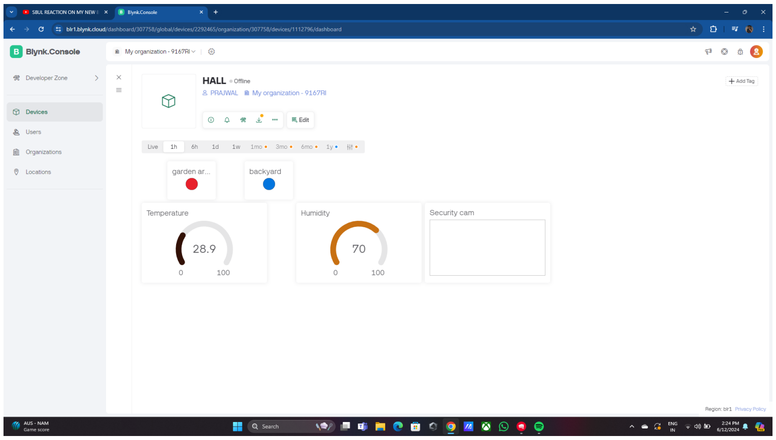

Fig. 4. Blynk cloud of Hall

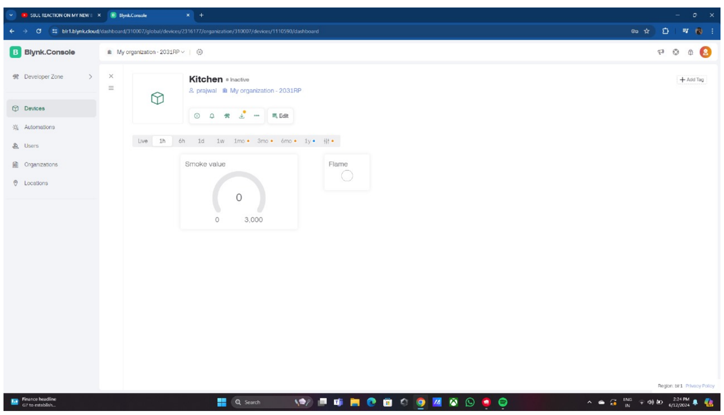

Fig. 5. Blynk cloud of Kitchen

server, which serves as a central hub. Users can then monitor their home characteristics from any location using the Blynk smartphone app or web dashboard. Furthermore, users may remotely control lighting, appliances, and other linked devices by sending control commands to the microcontrollers via the Blynk app or dashboard. Our home automation system gives consumers an easy and centralized way to monitor and control their home environment from any location with an internet connection through the Blynk cloud platform.

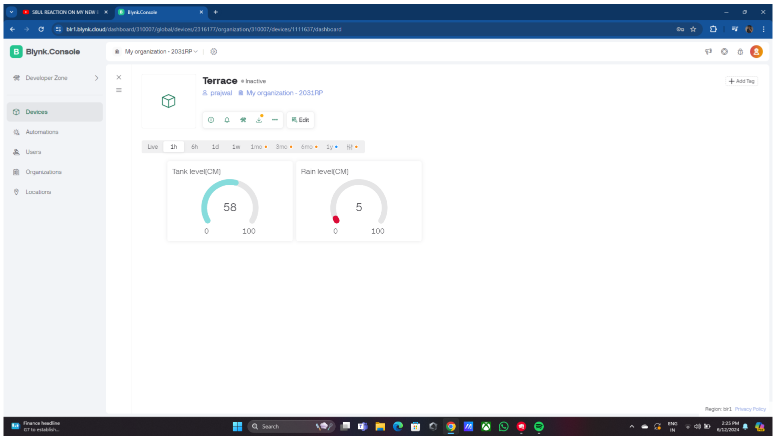

Fig. 6. Blynk cloud of Terrace

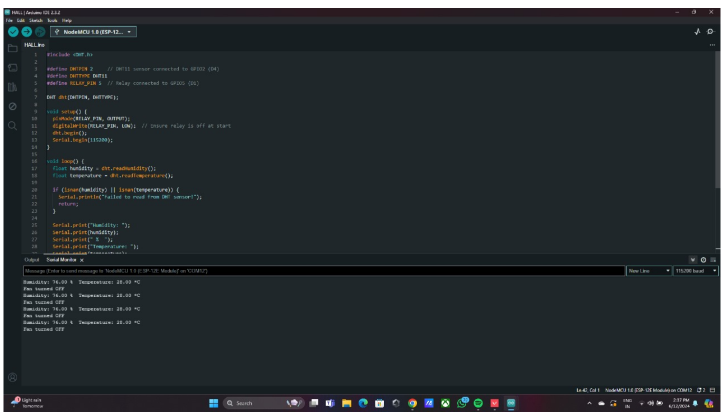

Fig. 7. Serial Monitor

In Fig 7, the serial monitor displays the values or data that are sent to it.

4 Conclusion

This home automation work uses ESP32 and ESP8266 modules and various sensors to produce a responsive and intelligent home. The main door's video streaming, the hallway's temperature and motion sensors, the kitchen's gas and flame detection, and the terrace's rain and water level sensors are some of the essential features. Web browsers or smartphones can access real-time control, monitoring, and alerts through cloud platform integration. This work improves convenience, security, and energy efficiency by automating basic tasks like lighting, fan control, and safety monitoring. This gives homeowners an advanced option for modern-day living. An ESP microcontroller-based home automation system may incorporate 5G, AI, and machine learning for more intelligent monitoring and control. Functionality and security will be improved via intelligent actuators, biometric identification, and advanced sensors.

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