



Low Power Smart Home Automation with Smart Home Security System Over the Cloud

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<https://doi.org/10.55041/ijst.v2i4.278>

Cite this Article: A.Shirisha, T.Niharika, & Y.Vasavi, (2026). Low Power Smart Home Automation with Smart Home Security System Over the Cloud. International Journal of Science, Strategic Management and Technology, 02(04). <https://doi.org/10.55041/ijst.v2i4.278>

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Abstract: This article outlines a comprehensive smart home automation system that utilizes ESP32 and ESP32-CAM modules, along with IoT cloud integration, to provide a seamless and secure automation experience. The system integrates various sensors, actuators, and cameras to enable remote control, monitoring, and intelligent security features for a smart home environment. The proposed system focuses on enhancing convenience, energy efficiency, and safety for homeowners. The majority of appliances and items have become automated as a result of the rapid advancement of technology in recent years. The rise of automated systems is a result of people’s preference for them over manual ones in today’s society. IoT is a developing technology that enables people to quickly connect to the cloud, manage hardware by the internet, and operate equipment from a distance IoT technology is extensively employed in the construction of smart cities, smart houses, smart roads and agricultural sector. Recently, individuals have entirely changed, surrounded by technology and the internet, and they feel compelled to access the majority of things remotely by their smart phones or the internet since they are more economical and energy-efficient. Modern home are replacing traditional switches with remote control systems that may be used with smartphones. Home automation will be able to provide better security; comfort and it could be extremely helpful for elderly or handicapped people to easily operate the home appliances. This module is very simple to install and easy to use, and it regulates the household appliances. This

paper is entirely based on low-cost and dependable Internet of Things-based home control monitoring system.

Keywords- ESP32, IoT, ESP32-CAM, Smart Home Automation, IR sensor, Home surveillance system, IoT cloud based system

Introduction: The main concept behind IoT-based smart home automation with smart security system is for making a house smarter, more energy-efficient and easier to live in by allowing the home gadgets to interact with one another and be managed remotely through a smartphone. Home automation is one-of-a-kind technology that can control and communicate practically every part of your home. The phrase "smart home automation with smart security system over the cloud" refers to the integration of all domestic amenities and equipment. A high degree of automation framework is developed to control the home devices inside the premises in light of the benefits of WiFi. "It aims to set up a home automation system utilizing a standard microcontroller and a web server with Wi-Fi technology".[16] IoT-based smart home automation with smart security system, utilizing state-of-the-art technologies such as the ESP32, ESP32-CAM, IR sensor, PIR sensor and 8-module relay. By leveraging the power of the ESP32 and ESP32-CAM, this smart home automation system is capable of performing complex tasks such as video surveillance and remote monitoring. The phrase "cloud" refers to a network of



remote servers located on the internet that together provide various services such as storage, processing power, and applications. Controlling the smart home automation from the blynk cloud involves sending commands or instructions from the cloud service to the ESP32 devices. The blynk cloud service should provide an “Blynk Auth Token Number” that allows external communication and control. This Blynk Auth Token Number exposes endpoints or methods for sending commands and receiving data from connected devices. Once the command is processed, the blynk cloud service sends a message or notification to the ESP32 and ESP32-CAM device. By establishing this cloud-to-device communication method, users may remotely control their smart home gadgets, triggering activities and video monitoring their status via the user interface of the blynk cloud service. This project's purpose is to build a smart home automation system with a smart security system.

Objective:

The main objective of this project is to design and implement a smart home automation system with an integrated security mechanism using IoT and cloud technology, enabling users to remotely control and monitor household appliances through a smartphone or web interface. The system aims to enhance home security by incorporating motion detection and real-time surveillance, while also monitoring environmental conditions such as temperature and humidity. Additionally, it focuses on improving energy efficiency by automating device operation, providing instant alerts for abnormal activities, and ensuring a low-cost, user-friendly solution that can be easily deployed in modern homes.

Problem Statement:

The rapid advancement of technology has increased the demand for smart and automated living environments, yet many homes still rely on manual control of appliances and basic security systems, leading to inconvenience, energy wastage, and lack of real-time monitoring. Traditional systems do not provide remote access or intelligent control, making it difficult for users to manage appliances or ensure

home security when they are away. Additionally, existing security setups often fail to offer instant alerts or live surveillance during unauthorized access. Therefore, there is a need for an efficient, low-cost solution that integrates home automation with a smart security system using Internet of Things (IoT) and cloud technology, enabling users to remotely control devices, monitor environmental conditions, and receive real-time security updates for improved safety, comfort, and energy efficiency.

Literature Review

[1] This study presents a smart home system based on ESP32 and the MQTT protocol, focusing on efficient communication between devices. It enables remote monitoring and control of home appliances such as lighting and environmental sensors. The system improves user convenience by allowing real-time access and control through the internet, making home management more flexible and efficient.

[2] This research focuses on energy monitoring in smart homes using ESP32 technology. It provides real-time data on energy consumption, helping users analyze usage patterns and make informed decisions to reduce electricity costs. The system promotes energy efficiency by enabling better control and optimization of household appliances.

[3] This work emphasizes the implementation of security features in smart homes using ESP32. It includes motion sensors, door sensors, and advanced techniques like face recognition to enhance safety. The system allows homeowners to monitor their homes remotely, providing an additional layer of protection against unauthorized access.

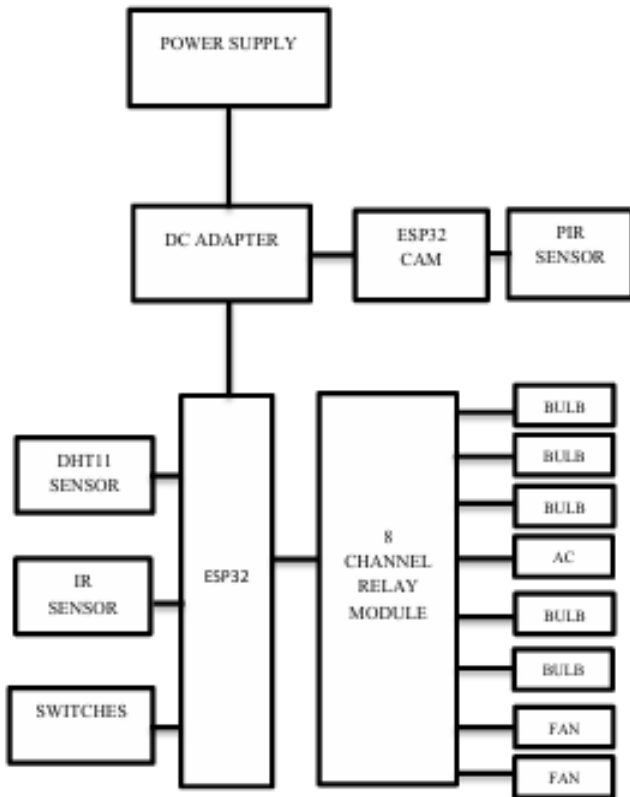
[4] This paper discusses the integration of voice assistants such as Amazon Alexa and Google Assistant with ESP32-based smart home systems. It enables users to control appliances using voice commands, improving ease of use and accessibility. This approach enhances user interaction and supports hands-free operation in smart environments.

[5] This study explores the integration of various IoT devices like smart locks, cameras, and thermostats with ESP32. It demonstrates how multiple smart

devices can be connected to form a complete home automation ecosystem. The system offers scalability and flexibility, allowing users to expand and customize their smart home setup as needed.

3. System Architecture and Components

3.1 System Architecture:



3.2 Hardware Components:

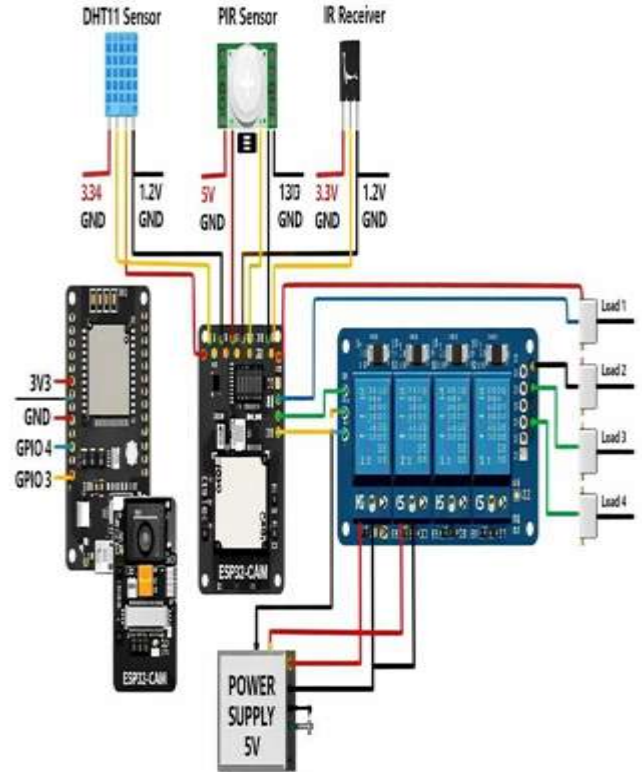
The following hardware components and sensors are utilized to create the proposed system.

- 1) ESP32 V1 dev kit
- 2) DHT11 sensor
- 3) TSOP1838 IR sensor
- 4) 4 channel 5v relay module
- 5) 5-volt DC adapter
- 6) ESP32-CAM

7) FTDI 232 USB to serial Interface Board

8) PIR sensor

4. CIRCUIT DIAGRAM



5. CODE

5.1 ESP32 CODE

```
#define BLYNK_PRINT Serial
#include <WiFi.h>
#include <BlynkSimpleEsp32.h>
#include <DHT.h>
#include <IRremote.h>
char auth[] = "YOUR_BLYNK_AUTH_TOKEN";
char ssid[] = "YOUR_WIFI_NAME";
char pass[] = "YOUR_WIFI_PASSWORD";
#define RELAY1 26
#define RELAY2 25
#define PIR_PIN 14
```



```
#define DHTPIN 4
#define IR_PIN 27
#define BUTTON1 33
#define BUTTON2 32
#define DHTTYPE DHT11
DHT dht(DHTPIN, DHTTYPE);
IRrecv irrecv(IR_PIN);
decode_results results;
bool relay1State = LOW;
bool relay2State = LOW;
BlynkTimer timer;
BLYNK_WRITE(V0) {
  relay1State = param.asInt();
  digitalWrite(RELAY1, relay1State);
}
BLYNK_WRITE(V1) {
  relay2State = param.asInt();
  digitalWrite(RELAY2, relay2State);
}
void sendDHT() {
  float temp = dht.readTemperature();
  float hum = dht.readHumidity();
  if (!isnan(temp) && !isnan(hum)) {
    Blynk.virtualWrite(V5, temp);
    Blynk.virtualWrite(V6, hum);
  }
}
void checkMotion() {
  int motion = digitalRead(PIR_PIN);
  if (motion == HIGH) {
    Serial.println("Motion Detected!");
    Blynk.logEvent("motion_alert", "Motion Detected in Home!");
  }
}
void checkButtons() {
  if (digitalRead(BUTTON1) == LOW) {
    relay1State = !relay1State;
    digitalWrite(RELAY1, relay1State);
    Blynk.virtualWrite(V0, relay1State);
    delay(300);
  }
  if (digitalRead(BUTTON2) == LOW) {
    relay2State = !relay2State;
    digitalWrite(RELAY2, relay2State);
    Blynk.virtualWrite(V1, relay2State);
    delay(300);
  }
}
void checkIR() {
  if (irrecv.decode(&results)) {
    Serial.println(results.value, HEX);
    if (results.value == 0xFFA25D) { // Button 1
      relay1State = !relay1State;
      digitalWrite(RELAY1, relay1State);
      Blynk.virtualWrite(V0, relay1State);
    }
    if (results.value == 0xFF629D) { // Button 2
      relay2State = !relay2State;
      digitalWrite(RELAY2, relay2State);
    }
  }
}
```

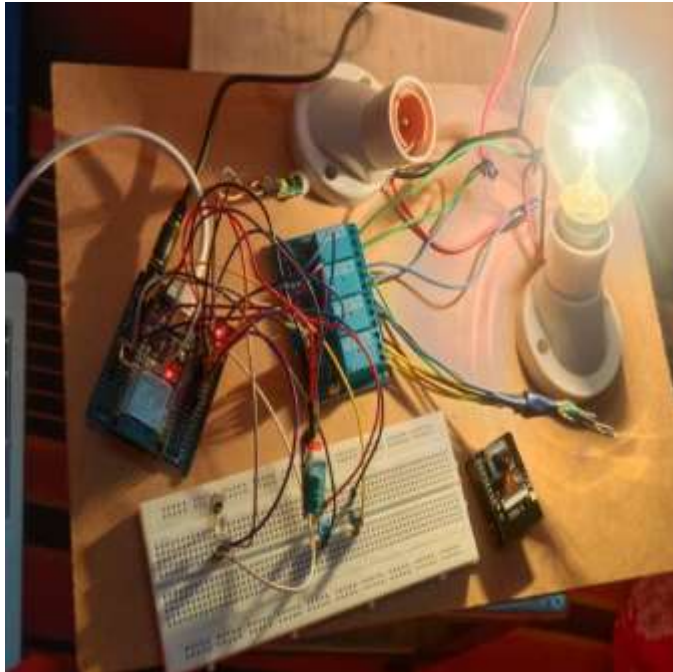


```
Blynk.virtualWrite(V1, relay2State);
}
irrecv.resume();
}
void setup() {
  Serial.begin(115200);
  pinMode(RELAY1, OUTPUT);
  pinMode(RELAY2, OUTPUT);
  pinMode(PIR_PIN, INPUT);
  pinMode(BUTTON1, INPUT_PULLUP);
  pinMode(BUTTON2, INPUT_PULLUP);
  digitalWrite(RELAY1, LOW);
  digitalWrite(RELAY2, LOW);
  dht.begin();
  irrecv.enableIRIn();
  Blynk.begin(auth, ssid, pass);
  timer.setInterval(2000L, sendDHT);
  timer.setInterval(1000L, checkMotion);
}
void loop() {
  Blynk.run();
  timer.run();
  checkButtons();
  checkIR();
}
```

6.RESULT

4.2 ESP32 CAM CODE

```
#if defined(CAMERA_MODEL_WROVER_KIT)
#define PWDN_GPIO_NUM -1
#define RESET_GPIO_NUM -1
#define XCLK_GPIO_NUM 21
```



HARDWARE OUTPUT



BLYNK APP OUTPUT

7. ADVANTAGES AND APPLICATIONS

7.1 ADVANTAGES

- Multiple Control Modes Devices can be controlled via:
 - i. Blynk app (online)
 - ii. IR remote (offline) .
 - iii. Manual switches

- Support for Elderly and Disabled People Makes it easier to operate home appliances without physical effort.
- Remote Access Appliances can be controlled from anywhere using a mobile app.
- Improved Security PIR sensor and ESP32-CAM provide motion detection and surveillance.
- Energy Saving Devices can be turned off automatically, reducing power consumption.
- User Friendly Easy to operate using mobile app, IR remote, or switches.
- Real-Time Monitoring Users receive instant updates and alerts on their smartphone.

7.2 APPLICATIONS

1. Remote Home Control

- Control lights, fans, and appliances from anywhere using the Blynk app.
- Uses ESP32 with relay module to switch devices ON/OFF via cloud.

2. Smart Security Surveillance

- ESP32-CAM captures images/video when motion is detected.
- Useful for real-time monitoring and intruder detection.

3. Motion Detection Alert System

- PIR sensor detects human movement.
- Automatically triggers alerts or buzzer notifications to the user's phone.

4. Temperature & Humidity Monitoring

- DHT11 sensor monitors environmental conditions.
- Helps in maintaining comfortable living conditions and can trigger cooling systems automatically

5. Energy Management System

- Users can remotely turn off unused appliances.
- Reduces electricity consumption and improves energy efficiency.

6. IR-Based Device Control

- TSOP IR sensor allows control of appliances using IR remotes.
- Can integrate traditional remote-controlled devices into smart systems.

8.FUTURE SCOPE

The proposed smart home automation and security system can be further enhanced by improving energy efficiency and optimizing power consumption. Future developments may include the use of advanced sensors and energy monitoring systems that can automatically adjust appliance usage based on real-time conditions. This will help in reducing electricity bills and promoting sustainable energy usage. Another important area of improvement is the integration of advanced security features such as facial recognition, voice recognition, and AI-based intrusion detection. By incorporating machine learning algorithms, the system can identify unusual activities and provide more accurate alerts. This will make the home security system more intelligent and reliable. The system can also be expanded by integrating additional IoT devices and making it compatible with voice assistants like Google Assistant or Alexa. Future work can focus on improving data privacy and security by implementing stronger encryption techniques. Additionally, developing a dedicated mobile application with enhanced user interface and features can further improve user experience and make the system more commercially viable.

9.CONCLUSION

The smart home automation with smart security system successfully demonstrates the application of IoT technology in controlling and monitoring home appliances. By using ESP32, ESP32-CAM, and various sensors, the system provides an efficient and reliable solution for home automation. It allows users to control devices remotely and monitor their home environment in real time. The integration of cloud computing through the Blynk IoT platform enhances the system's functionality by enabling remote access, real-time data updates, and instant notifications. The inclusion of security features such as motion detection and camera surveillance ensures improved safety for the users. The system is user-friendly and can be easily operated using a smartphone. Overall, the project provides a cost-effective and scalable solution for modern

smart homes. It improves convenience, energy efficiency, and security, making daily life easier and more comfortable. With further enhancements and advancements, this system has the potential to be developed into a fully automated and commercially successful smart home solution.

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