

# Smart Home Automation Using IOT

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**Abstract:** *Smart Home Automation using the Internet of Things (IoT) is an advanced technology that allows users to control and monitor household appliances through the internet. It connects various devices such as lights, fans, air conditioners, security systems, and other home appliances to a central system, enabling remote access using smartphones or computers..*

**Keywords:** *Smart Home Automation.*

## I. INTRODUCTION

Smart Home Automation using the Internet of Things (IoT) is an advanced technology that allows users to control and monitor household appliances through the internet. It connects various devices such as lights, fans, air conditioners, security systems, and other home appliances to a central system, enabling remote access using smartphones or computers.

The main objective of this project is to provide convenience, energy efficiency, and improved security. With the help of IoT, users can automate daily tasks like turning lights on/off, adjusting temperature, or monitoring home security from anywhere in the world. Sensors and microcontrollers collect data and communicate with cloud platforms to perform actions automatically or based on user commands.

This system reduces human effort, saves energy, and enhances the quality of life by making homes smarter and more efficient. As technology continues to grow, smart home automation is becoming an important part of modern living.

Smart Home Automation using the Internet of Things (IoT) is a rapidly growing technology that transforms a traditional home into an intelligent living space by integrating hardware, software, and communication networks. In this system, various devices such as sensors, actuators, and microcontrollers are connected through the internet, allowing them to communicate with each other and with the user. Common components include temperature sensors, motion detectors, light sensors, and smart switches, which collect real-time data from the environment. This data is processed by controllers (like Arduino or NodeMCU), and actions are performed automatically or based on user input through mobile applications. The system can be accessed remotely, enabling users to control appliances like lights, fans, air conditioners, and security cameras from anywhere, ensuring convenience and flexibility. Additionally, smart home automation improves energy efficiency by reducing unnecessary power consumption through scheduling and automation features. It also enhances safety by incorporating features such as intrusion detection, fire alarms, and surveillance systems. Overall, this technology plays a significant role in modern smart living by making homes more comfortable, secure, and energy-efficient while reducing human effort and operational costs.

## II. LITERATURE REVIEW

Smart home automation using the Internet of Things (IoT) has been widely studied by researchers over the past decade due to its potential to improve comfort, security, and energy efficiency. According to various research papers, early home automation systems were limited to basic control mechanisms, but with the advancement of internet connectivity and smart devices, these systems have evolved into intelligent and interconnected environments.

Several studies have focused on the architecture and design of IoT-based home automation systems. Research shows that these systems typically consist of sensors, actuators, microcontrollers, and cloud platforms that work together to collect and process real-time data. A review paper on IoT home automation highlights that low-cost hardware and smartphones have played a major role in making these systems more accessible and practical for everyday use.



Energy management is another important area explored in the literature. Researchers have proposed IoT-based smart energy systems that optimize electricity consumption by automatically controlling appliances based on user behavior and environmental conditions. These systems help reduce energy wastage and improve efficiency, although challenges such as scalability and integration with renewable energy sources still exist.

In addition, many studies emphasize the role of advanced technologies like Artificial Intelligence (AI) and machine learning in enhancing smart home systems. These technologies enable systems to learn user preferences, predict actions, and automate decision-making processes, thereby improving user experience and system performance.

Despite significant advancements, the literature also identifies several challenges in IoT-based home automation. Security and privacy issues remain major concerns, as connected devices are vulnerable to hacking and unauthorized access. Other challenges include lack of standardization, interoperability between devices, and high initial setup costs.

### **III. COMPONENT AND DATA-SHEET**

The basic component used in this project its description and function is given bellow.

- NodeMCU
- Relay Module
- Battery
- Buck Converter
- Push Button
- LED Bulb

#### **NodeMCU ESP8266 (Controller)**



NodeMCU is the main brain of the system. It connects to Wi-Fi and receives commands from your mobile or internet. Based on the command, it sends signals to the relay module to control devices.

#### **Working**

##### **1. Connects to Wi-Fi**

It connects to your home Wi-Fi network, allowing communication with your mobile or app.

##### **2. Receives Commands**

When you press a button in the app (like turning ON a light), the command is sent to the NodeMCU.

##### **3. Processes the Signal**

The NodeMCU reads the command and decides which device to control.

##### **4. Controls Relay Module**

It sends a signal to the relay module (HIGH/LOW), which turns the connected bulb ON or OFF.

##### **5. Handles Manual Input**

It can also read signals from push buttons and control devices without internet.



#### **Information About NodeMCU**

- Based on ESP8266 Wi-Fi module
- Works on 3.3V power supply
- Has digital input/output pins (GPIO)
- Can be programmed using Arduino IDE
- Supports IoT applications (remote control, automation)

#### **Relay Module**



The relay module is an important part of your Smart Home Automation system using the Internet of Things (IoT). It acts as a switch that controls high-voltage devices like bulbs using a low-voltage signal from the NodeMCU.

#### **Working**

1. Receives Signal from NodeMCU

The NodeMCU sends a HIGH or LOW signal to the relay input pin.

2. Activates Electromagnet

Inside the relay, an electromagnet gets activated when the signal is received.

3. Switches the Circuit

The relay changes its internal contact:

- o ON state → Current flows → Bulb glows
- o OFF state → Current stops → Bulb turns OFF

4. Controls Appliances Safely

It allows low-power circuits (NodeMCU) to control high-power devices (bulbs).

#### **Information About Relay Module**

- Works as an electrical switch
- Has 2 channels → can control 2 devices
- Operates on 5V supply
- Provides isolation between control circuit and high voltage
- Contains components like relay coil, transistor, diode, LEDs

#### **18650 Li-ion Battery**

The 18650 Li-ion Battery is the power source of your Smart Home Automation system using the Internet of Things (IoT).





### **Working**

In your circuit, the battery works like this:

1. Provides Power Supply

The battery stores electrical energy and supplies DC voltage (3.7V–4.2V) to the circuit.

2. Supplies Power to Converter

The output of the battery is given to the DC-DC buck converter, which adjusts the voltage to a safe level.

3. Powers All Components

After voltage regulation, power is supplied to:

o NodeMCU (controller)

o Relay module (switching device)

4. Ensures Portable Operation

Since it is rechargeable, the system can work without direct mains supply.

### **Information About 18650 Battery**

- Type: Lithium-ion rechargeable battery
- Voltage: 3.7V nominal (4.2V fully charged)
- Shape: Cylindrical (18mm diameter, 65mm length → “18650” )
- High energy storage capacity
- Used in power banks, laptops, and IoT projects

### **DC-DC Buck Converter**



The DC-DC Buck Converter (Voltage Regulator) is used to reduce and control voltage in your Smart Home Automation system based on the Internet of Things (IoT).



### **Working**

In your circuit, the buck converter works like this:

1. Receives Power from Battery

The 18650 battery provides around 3.7V–4.2V, which may not be stable for all components.

2. Steps Down / Regulates Voltage

The buck converter adjusts this voltage to a safe and constant level required by:

- o NodeMCU
- o Relay module

3. Provides Stable Output

It ensures that components receive proper voltage without fluctuation, preventing damage.

4. Improves Efficiency

It converts power efficiently with less heat loss compared to linear regulators.

### **Information About Buck Converter**

- Type: Step-down voltage regulator
- Converts higher voltage → lower voltage
- Has adjustable output (using potentiometer)

### **Push Button Switch**



The Push Button Switch is used for manual control in your Smart Home Automation system based on the Internet of Things (IoT).

### **Working**

In your circuit, the push button works like this:

1. User Presses Button

When you press the switch, it completes an electrical circuit.

2. Signal Sent to NodeMCU

The button sends a HIGH or LOW signal to the NodeMCU input pin.

3. NodeMCU Processes Input

The NodeMCU detects the button press and decides what action to perform.

4. Controls Relay Module

Based on the input, the NodeMCU sends a signal to the relay to:

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- o Turn ON the bulb
  - o Turn OFF the bulb
  - 5. Works Without Internet
- Even if Wi-Fi is not available, you can control appliances manually using the button.

#### **Information About Push Button**

- Type: Momentary switch (works only when pressed)
- Has 2 or 4 pins
- Used as an input device
- Small, low-cost, and easy to use

#### **LED Bulb**



The LED Bulb acts as the output device in your Smart Home Automation system using the Internet of Things (IoT). It represents the appliance (like lights in a home) that you control.

#### **Working**

In your circuit, the LED bulb works like this:

##### **1. Receives Power Through Relay**

The bulb is connected to the relay module, not directly to the NodeMCU.

##### **2. Relay Controls Current Flow**

o When the relay is ON → Circuit is completed → Current flows → Bulb glows

o When the relay is OFF → Circuit is broken → No current → Bulb OFF

##### **3. Controlled by NodeMCU**

The NodeMCU sends signals to the relay based on:

o Mobile app commands (via Wi-Fi)

o Push button input (manual control)

##### **4. Displays Output**

The glowing bulb shows that the system is working and the command is executed.



### **Information About LED Bulb**

- Type: Light Emitting Diode (LED)
- Converts electrical energy into light
- Consumes less power compared to traditional bulbs
- Has long lifespan
- Available in different voltages and sizes

### Scope of Smart Home Automation using IoT

#### 1. Remote Control of Home Devices

- Users can control lights, fans, AC, and appliances from anywhere using a mobile app or internet.
- Useful for convenience and saving time.

#### 2. Energy Efficiency and Power Saving

- Devices can automatically turn OFF when not in use.
- Helps reduce electricity bills and energy wastage.

#### 3. Enhanced Security System

- Integration of smart locks, CCTV cameras, motion sensors, and alarms.
- Provides real-time alerts on mobile if any suspicious activity is detected.

#### 4. Automation Based on Sensors

- Lights turn ON/OFF based on motion or sunlight.
- Fans/AC adjust automatically based on temperature.
- Improves comfort without manual effort.

#### 5. Voice Control Integration

- Can be connected with voice assistants like:
  - o Google Assistant
  - o Amazon Alexa
- Users can control devices using voice commands.

#### 6. Scalability and Future Expansion

- More devices (like smart fridge, smart TV, smart doorbell) can be added later.
- System can be upgraded easily with new technologies.

#### 7. Support for Elderly and Disabled People

- Makes daily tasks easier through automation and voice control.
- Provides safety with emergency alerts.

#### 8. Integration with Smart City Concepts

- Can be part of larger IoT-based systems like smart grids and smart buildings.
- Supports modern digital lifestyle.

#### 9. Data Monitoring and Analysis

- Tracks energy usage and device activity.
- Helps users make better decisions for efficient usage.



#### Non-Functional Scope (Requirements)

Non-functional scope means how well the system works, not what it does.

##### 1. Performance

- System should respond quickly to user commands (like turning ON/OFF devices).
- Minimal delay (low latency) is important.

##### 2. Reliability

- System should work properly without failure.
- Devices should respond correctly every time.

##### 3. Security

- Protects system from unauthorized access.
- Data (user info, device control) should be encrypted.
- Safe login system is required.

##### 4. Scalability

- System should support adding more devices in future.
- Should handle increased load without slowing down.

##### 5. Usability (User-Friendly)

- Easy-to-use mobile app or interface.
- Simple controls so even non-technical users can operate it.

##### 6. Availability

- System should be available anytime (24/7).
- Should work even with minor network issues.

##### 7. Maintainability

- Easy to update, repair, or modify the system.
- Software updates should be simple.

##### 8. Compatibility

- Should work with different devices and platforms (Android, iOS, etc.).
- Supports various sensors and smart devices.

##### 9. Energy Efficiency

- System itself should consume less power.
- Helps in overall energy saving.

##### 10. Safety

- Prevents electrical hazards or device damage.
- Ensures safe operation of appliances.

#### Methodology / Approach

##### 1. Requirement Analysis

- Identify what devices to control (lights, fans, appliances).



- Decide features like remote control, automation, security, etc.
2. System Design
    - Design the overall architecture of the system.
    - Select components like:
      - o Microcontroller (Arduino / NodeMCU)
      - o Sensors (temperature, motion)
      - o Relay modules (to control appliances)
    - Plan how devices will connect through the internet.
  3. Hardware Implementation
    - Connect sensors, relays, and appliances to the microcontroller.
    - Ensure proper wiring and power supply.
    - Assemble the physical setup of the system.
  4. Software Development
    - Write code to control devices using microcontroller.
    - Develop a mobile app or web interface.
    - Use IoT platforms like:
      - o Blynk
      - o ThingSpeak
  5. Communication Setup
    - Connect system to internet using Wi-Fi module (like NodeMCU).
    - Enable communication between mobile app and devices via cloud/server.
  6. Testing and Debugging
    - Test each component (sensor, relay, app).
    - Fix errors in hardware and software.
    - Ensure system works correctly in different conditions.
  7. Integration
    - Combine hardware and software into one working system.
    - Ensure smooth communication between all components.
  8. Deployment
    - Install system in a real environment (home setup).
    - Make it ready for actual use.
  9. Maintenance and Upgradation
    - Regularly update software.
    - Add new features or devices if required.

#### Advantages

1. Convenience
  - Control home appliances easily using mobile or internet.



- No need to manually switch ON/OFF devices.
- 2. Remote Access
  - Users can control devices from anywhere in the world.
  - Useful when you are away from home.
- 3. Energy Efficiency
  - Devices automatically turn OFF when not needed.
  - Helps in saving electricity and reducing bills.
- 4. Improved Security
  - Smart cameras, motion sensors, and alarms increase home safety.
  - Instant alerts on mobile in case of unusual activity.
- 5. Time Saving
  - Automation reduces manual work.
  - Tasks are completed faster and automatically.
- 6. Comfort and Luxury
  - Adjust lighting, temperature, and appliances automatically.
  - Creates a comfortable living environment.
- 7. Voice Control
  - Can control devices using voice assistants like:
    - o Google Assistant
    - o Amazon Alexa
- 8. Support for Elderly and Disabled
  - Easy control of devices without physical effort.
  - Improves independence and safety.
- 9. Scalability
  - New devices and features can be added easily.
  - System can grow as per user needs.
- 10. Monitoring and Control
  - Users can monitor device status in real-time.
  - Helps in better management of home appliances.

### **Applications**

1. Smart Lighting System
  - Automatically control lights based on motion or time.
  - Lights can be turned ON/OFF using mobile.
2. Smart Security System
  - Use of CCTV cameras, motion sensors, and smart locks.



- Sends alerts to user in case of intrusion.
- 3. Climate Control System
  - Automatic control of fan, AC, or heater based on temperature.
  - Maintains comfortable room conditions.
- 4. Smart Energy Management
  - Monitors electricity usage.
  - Helps in reducing power consumption and saving bills.
- 5. Home Appliance Control
  - Control TV, refrigerator, washing machine, etc. remotely.
  - Schedule devices to work at specific times.
- 6. Voice-Based Home Control
  - Devices can be controlled using voice assistants like:
    - o Google Assistant
    - o Amazon Alexa
- 7. Smart Door System
  - Automatic door locking/unlocking system.
  - Can be controlled remotely or via password/fingerprint.
- 8. Fire and Gas Detection System
  - Detects fire or gas leakage using sensors.
  - Sends emergency alerts to users.
- 9. Smart Irrigation (Garden System)
  - Automatically waters plants based on soil moisture level.
  - Saves water and effort.
- 10. Healthcare Monitoring at Home
  - Monitors patient health (like heart rate, temperature).
  - Sends data to doctors or family members.

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