International Journal of Scientific Research in Engineering and Management (IJSREM)
Volume: 09 Issue: 05 | May – 2025 SJIF Rating: 8.586 ISSN: 2582-3930

IOT Based Smart Home Automation

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Abstract

The Smart Home Automation project aims to design and implement a system that automates and remotely controls various household appliances using modern technologies such as the Internet of Things (**IoT**), microcontrollers, and mobile applications. The primary objective is to enhance convenience, improve energy efficiency, and increase security within the home environment. Our system enables users to control lights, fans, temperature, and security features such as cameras and door locks through a smartphone or voice assistant. The integration of sensors allows for **real-time monitoring** and automation based on environmental conditions, such as turning off lights when no motion is detected. This project demonstrates how smart automation can transform traditional homes into intelligent, responsive living spaces that cater to the user's lifestyle and needs

Introduction

Smart Home Automation is an innovative concept that integrates technology with home appliances and systems, allowing users to control and monitor them remotely. This project focuses on developing a smart home system using **IoT**-based solutions, where various household devices such as lights, fans, and security systems can be managed through a smartphone application or voice commands.

Our system utilizes microcontrollers like **Arduino/NodeMCU**, sensors (such as motion, temperature, and gas sensors), and Wi-Fi modules to enable seamless communication between devices. The integration of automation features, such as automatic light control based on motion detection or temperature-based fan operation, enhances both convenience and energy efficiency. By automating daily tasks and enabling real-time control, this system not only provides comfort but also contributes to better energy management and home safety.

This project reflects the growing trend of digital transformation in homes and aims to create a smarter, more secure, and efficient living environment for users.

Objective

1. Enhance convenience by automating routine home tasks.

2. Improve energy efficiency by controlling devices based on sensor data. **3.**Increase home security through real-time monitoring and alerts.

4. Provide remote access and control using a smartphone application or voice commands.

Literature Review

Smart home automation has gained significant attention in recent years due to the rapid advancement in Internet of Things (**IoT**), wireless communication, and embedded systems. Various studies and projects have explored different technologies and architectures to implement intelligent home control systems.

Several researchers have implemented home automation using microcontrollers such as **Arduino** and **NodeMCU**, which allow for the integration of sensors and actuators to control devices like lights, fans, and appliances. Wireless communication technologies such as Wi- Fi, Bluetooth, and **Zigbee** have been commonly used for data transmission between devices and user interfaces.

Additionally, sensor-based automation has been widely studied. Motion sensors, temperature sensors, and gas sensors have been integrated to automate lighting, fan speed, and safety alerts, respectively. These systems not only provide comfort but also contribute to energy conservation and safety improvements.

The literature highlights that while many smart home systems exist, combining affordability, scalability, and ease of use remains a challenge. Our project builds upon these ideas by **creating a cost-effective** and user-friendly smart home solution using **IoT**, sensor integration, and wireless communication, aiming to bring smart technology into everyday living.

Methodology

The Smart Home Automation system was developed through a structured approach involving both hardware and software components. The following steps outline the methodology adopted:

1. Requirement Analysis

We began by identifying the key requirements of the system, such as device control, real- time monitoring, user interface design, and system security. The goal was to automate appliances like lights and fans and integrate sensors for smart decision-making.

2. Component Selection

Based on the requirements, suitable components were chosen: **1.Microcontroller:** NodeMCU (**ESP8266**) for its built-in Wi-Fi capability.
2.Sensors: Motion sensor (**PIR**), temperature sensor (**DHT11)**, gas sensor (**MQ-2**). 3.**Output Devices:** Relays to control appliances like lights and fans.

4.Platform: Blynk app for mobile-based control.

3. Circuit Design and Integration

The sensors and actuators were connected to the **NodeMCU**, and a relay module was used to switch household appliances. A power supply unit was designed to safely power the components.

4. Software Development

The **Arduino** IDE was used to program the **NodeMCU** with logic for sensor input handling, appliance control, and communication with the **Blynk** app. The Blynk dashboard was configured for remote operation and real-time monitoring.

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5. Wireless Communication Setup

The **NodeMCU** was connected to a Wi-Fi network to enable **IoT** functionality. Commands from the mobile app were received via the internet and executed accordingly.

Existing Methods

In recent years, more advanced systems have been developed using Bluetooth or **Zigbee modules**, which allow wireless control within a short range. While these methods improved convenience, they still required users to be within a limited distance of the device.

Some existing smart home solutions use microcontrollers like **Arduino** and Raspberry Pi, combined with mobile applications, to automate appliances. However, these systems often face challenges such as high cost, complex

wiring, limited user interface design, or lack of internet-based control.

Commercial solutions like Amazon Alexa, Google Home, and **Apple HomeKit offer voice- based control** but are expensive and sometimes require proprietary hardware, making them less accessible to all users.

Advantage of current system

1. **Improved Convenience**

Existing smart home systems allow users to control appliances with a smartphone or voice assistant, reducing manual effort.

2. **Time-Saving**Automation features like scheduling and timers help save time by automating repetitive tasks.

3. **Energy Efficiency**

Smart systems can reduce energy consumption by turning off appliances when not in use or based on sensor input.

4. **Enhanced Security**

Many systems offer security features such as surveillance cameras, motion detectors, and smart locks for improved safety.

5. **Remote Access**

With internet connectivity, users can control and monitor their home appliances from anywhere in the world.

Disadvantages of Current Systems

1. **Lack of Remote Access**

Traditional systems require manual operation and do not allow users to control devices when they are away from home.

2. **Limited Automation**

Most existing systems lack intelligence and cannot automate tasks based on environmental conditions like motion, temperature, or time.

3. **High Cost**

Commercial smart home solutions (like Google Home or Alexa) are often expensive and may require additional proprietary hardware.

4. **Complex Installation**

Some systems involve complicated wiring or setup procedures, making them difficult for regular users to install or maintain.

5. **Short Range Control**

Systems based on Bluetooth or IR remote control have a limited range and cannot be used from outside the home.

Proposed System

The Smart Home Automation system aims to overcome the limitations of traditional and existing smart systems by introducing an affordable, user-friendly, and **IoT**-based solution. The system uses a **NodeMCU (ESP8266)** microcontroller integrated with sensors (such as motion, temperature, and gas sensors) and actuators to control appliances like lights, fans, and safety devices.

A mobile application (**such as Blynk**) is used to provide remote access and real-time monitoring, allowing users to control and automate their home from anywhere using a smartphone. The system is connected to the internet via Wi-Fi, enabling smooth communication between the user and the home devices.

System Requirements

The system requirements are divided into two categories: Hardware Requirements and Software Requirements.

1. Hardware Requirements

1. NodeMCU (ESP8266) – Microcontroller with built-in Wi-Fi for **IoT** connectivity. 2. **Relay Module** – To control high-voltage appliances like lights and fans.
Sensors

3. PIR Sensor – For motion detection.

4. DHT11 Sensor – For temperature and humidity monitoring. MQ-2 Sensor – For gas leakage detection.
5. Light Bulbs / Fan – Appliances to demonstrate automation.

6. Power Supply – 5V regulated power supply for the **NodeMCU** and **sensor**s. **Connecting Wires & Breadboard** – For circuit setup and testing.

2. Software Requirements

1. Arduino IDE – For programming the **NodeMCU microcontroller**. **2**. **Blynk App** – For mobile-based control and monitoring.
3. Blynk Library – To integrate **NodeMCU** with the **Blynk** platform.

4. Wi-Fi Connection – For enabling **IoT** functionality and remote access. **5**.G**oogle Assistant** (optional) – For voice control integration.

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