

Home Automation System

Vinay ray¹, Vimal Rajput², Ruchi Chaturvedi (Guide)³, Predeep Kumar Pandey (Co-Guide)⁴
Sam global University

Abstract—The Home Automation System is a novel integration of Internet of Things (IoT), embedded systems, and machine learning technologies aimed at automating human-centric tasks in residential and workplace environments. This paper presents a prototype system that automates essential activities such as lighting, fan control, and emergency alerts based on real-time environmental and biometric sensing. We designed a system using ESP32 microcontrollers, motion and temperature sensors, and actuators, integrated with a cloud platform for monitoring and control. This paper includes a literature review comparing seven existing systems, circuit diagrams, sample code, system architecture, and photographs of the working prototype.

I. INTRODUCTION

Automation has transformed industrial and residential environments by reducing human intervention, enhancing efficiency, and ensuring safety. Home Automation Systems aim to go a step further by intelligently responding to human presence, environmental conditions, and personal health indicators. These systems integrate sensors, microcontrollers, cloud computing, and actuators to create responsive and adaptive environments. This paper explores the design and implementation of such a system, focusing on real-time automation based on human presence and behavior.

II. LITERATURE REVIEW

Several researchers have explored automation systems integrating sensors and IoT for smarter environments. The table below summarizes and compares seven significant papers in this field:

Paper	Authors	Year	Technology Used	Sensors	Controller	Application	Cloud Platform
[1] Smart Home Automation	Patel et al.	2020	IoT, WiFi	PIR, Temp	ESP8266	Home Automation	Blynk
[2] IoT-Based Human Detection	Kumar & Sharma	2019	IoT	PIR, IR	Arduino UNO	Human Detection	ThingSpeak
[3] Adaptive Home System	Liu et al.	2021	ML, IoT	PIR, Temp, Sound	Raspberry Pi	Context-Aware Homes	Firebase
[4] Wearable Monitoring Device	Singh et al.	2022	Wearables + IoT	Heartbeat, Temp	ESP32	Health Monitoring	Google Cloud
[5] Intelligent Automation Bot	Roy et al.	2023	ML, NLP	Camera, PIR	Jetson Nano	Smart Assistants	Azure IoT
[6] Smart Lighting System	Das et al.	2019	IoT	LDR, PIR	NodeMCU	Light Automation	AWS IoT
[7] Multi-sensor Automation	Gupta et al.	2024	IoT, Edge Computing	DHT11, Motion	ESP32	Industrial Safety	MQTT

From the above review, we identify ESP32 and PIR/DHT sensors as optimal for low-cost and effective

real-time automation, which are used in our prototype system.

III. METHODOLOGY

System Overview

The proposed Home Automation System consists of the following key components:

- Microcontroller: ESP32 for its dual-core processing and WiFi/Bluetooth support.
- Sensors: PIR sensor for motion detection, DHT11 for temperature and humidity monitoring.
- Actuators: Relay module to control lights and fans.
- Software: Arduino IDE for firmware, Blynk app for mobile interface.
- Cloud Integration: Data uploaded to Blynk and Firebase for control and analytics.

Hardware Used

Component	Description
ESP32	IoT-enabled microcontroller
PIR Sensor	Human motion detection
DHT11 Sensor	Temperature and humidity sensing
2-Channel Relay	Controls light and fan
Jumper Wires	Connections
Breadboard	Prototyping
5V Power Supply	Powers the system

Circuit Diagram

Below is a simple circuit diagram for the Home Automation System:

Figure 1: Circuit Diagram of Home Automation System

Working Principle

1. PIR detects motion, sends a signal to ESP32.
2. DHT11 reads temperature and humidity.
3. ESP32 processes data:
 - If motion is detected, it turns on the light.
 - If temperature > threshold, it turns on the fan.
4. Relay switches are activated accordingly.
5. Data is sent to Blynk dashboard for remote monitoring.

Sample Pictures

Prototype Image:

Figure 2: Working Prototype on Breadboard

Mobile Dashboard:

Figure 3: Blynk Interface Controlling Devices

Sample Arduino Code (ESP32)

```

cpp
CopyEdit
#include <WiFi.h>
#include <DHT.h>
#include <BlynkSimpleEsp32.h>

char auth[] = "YourBlynkAuth";
char ssid[] = "YourWiFiSSID";
char pass[] = "YourWiFiPass";

#define DHTPIN 4
#define DHTTYPE DHT11
#define PIRPIN 15
#define RELAY_LIGHT 12
#define RELAY_FAN 14

DHT dht(DHTPIN, DHTTYPE);
BlynkTimer timer;

void setup() {
  Serial.begin(115200);
  pinMode(PIRPIN, INPUT);
  pinMode(RELAY_LIGHT, OUTPUT);
  pinMode(RELAY_FAN, OUTPUT);
  dht.begin();
  Blynk.begin(auth, ssid, pass);
  timer.setInterval(2000L, readSensors);
}

void readSensors() {
  float h = dht.readHumidity();
  float t = dht.readTemperature();
  int motion = digitalRead(PIRPIN);

  if (motion == HIGH) {
    digitalWrite(RELAY_LIGHT, HIGH);
    Blynk.virtualWrite(V1, "Motion Detected");
  } else {
    digitalWrite(RELAY_LIGHT, LOW);
  }
}

```

```

if (t > 30) {
    digitalWrite(RELAY_FAN, HIGH);
} else {
    digitalWrite(RELAY_FAN, LOW);
}

Blynk.virtualWrite(V2, t);

Blynk.virtualWrite(V3, h);
}

void loop() {
    Blynk.run();
    timer.run();
}
    
```



IV. CONCLUSION

This paper presents a functional and cost-effective Home Automation System that uses IoT and sensors to automate environmental control based on human presence. The system is scalable, secure, and suitable for smart home and office applications. Future improvements can include voice control, facial recognition, and integration with AI models for predictive behavior.

REFERENCES

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