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*I confirm that I understand my coursework needs to be submitted online via Google Classroom under the relevant module page before the deadline in order for my assignment to be accepted and marked.  
I am fully aware that late submissions will be treated as non-submission and a mark of zero will be awarded.*

## **Acknowledgement**

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**Abstract**

This project focuses on developing an easy-to-use home automation system using ESP32/Node MCU and sensors to improve home safety, convenience, and energy efficiency. It includes features like motion-activated lights, real-time temperature monitoring, and gas leak detection that triggers alarms and sends alerts. A mobile app allows users to control devices and monitor their homes, while voice assistant integration enables hands-free operation. The system is affordable, adaptable, and designed to make daily life simpler and safer.

## Table of Contents

1	Introduction .....	1
1.1	Current Scenario .....	1
1.2	Problem Statement and Project as a solution .....	1
2	Aim and Objectives .....	3
2.1	Aim.....	3
2.2	Objectives .....	3
3	Background.....	4
3.1	Expected Outcomes and Deliverables .....	4
3.2	Requirement Analysis .....	5
4	Individual Contribution Plan .....	7
5	Conclusion .....	8
6	References.....	9

**Table of Figures**

Figure 1: Home Automation System Architecture .....	4
Figure 2: Circuit Diagram for Home Automation.....	5

**Table of Tables**

Table 1: Work Breakdown .....	7
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# 1 Introduction

In recent years, the rise of the Internet of Things (IoT) has changed the way we interact with our environments, especially in home automation systems. IoT enables the seamless connection of devices, allowing them to be controlled or monitored remotely, which improves convenience, energy efficiency, and security. As a result, IoT has become an essential part of modern living, providing users with more control over their homes.

## 1.1 Current Scenario

The demand for smart home products has been growing due to the widespread use of smartphones and the internet, as well as the integration of Artificial Intelligence (AI) with home automation. The growing popularity of smart features, integrated with AI's ability to create more personalized, user-friendly experiences, is the major factor driving consumer's interest. According to the global home market report, the market was valued at USD 101.07 billion in 2023 and is expected to grow significantly, reaching USD 633.20 billion by 2032, with a compound annual growth rate (CAGR) of 22.9% from 2024 to 2032 (Fortune Business Insights, 2024). However, despite this rapid growth, many current smart home systems remain expensive and complex, limiting their widespread adoption, especially among people with lower budgets or lower technical knowledge.

## 1.2 Problem Statement and Project as a Solution

While existing smart home systems offer many advantages, most are either too expensive or complicated for the average consumer to install and use. Additionally, critical concerns, such as gas leaks, and fire hazards often go unaddressed in many smart home setups. With the increasing importance of home safety, there is a need for more affordable, user-friendly smart home solutions that can serve a broader audience.

This project aims to address these challenges by developing a simple, affordable home automation that focuses on enhancing both convenience and safety. By integrating sensors for motion detection, temperature monitoring, and gas leak/fire detection, the system will offer real-time alerts and remote-control features. Additionally, a voice assistant feature will enable hands-free operations. This project

aims to make homes safer, more energy-efficient and accessible to a wide range of users by combining these features in a simple, affordable system.



## **2 Aim and Objectives**

### **2.1 Aim**

The main aim of this home automation project is to make homes more energy-efficient, safer, and convenient. The motion sensor automates lights to reduce energy waste, while the gas sensor detects smoke and triggers alerts to prevent fire hazards. The integration of a smartphone app and Google Assistant enables remote, hands-free control. Additionally, a temperature sensor monitors room conditions to optimize energy use and comfort. This project offers a complete smart solution to enhance living standards.

### **2.2 Objectives**

1. To design a cost-effective system integrating IoT technology.
2. To develop a mobile app for real-time monitoring and control.
3. To implement motion-activated lighting.
4. To integrate safety features like gas leak detection and alerts.
5. To incorporate a voice assistant for hands-free operations.
6. To ensure scalability and ease of use.

### 3 Background

#### 3.1 Expected Outcomes and Deliverables

At the end of this project, the goal is to deliver a fully functional home automation system that enhances safety, convenience, and energy efficiency. The key deliverables include:

- **Motion Sensors** for automated lighting, reducing energy wastage.
- **Gas Sensors** for detecting smoke and gas leaks, triggering alarms, and sending alerts.
- **Temperature Sensors** for monitoring room conditions in real-time.
- **Mobile Application** for remote control and monitoring.
- **Voice Assistant Integration** for hands-free system operation.

#### System Architecture

The system architecture, illustrated in **Figure 1**, shows the interactions between the microcontroller (ESP32/Node MCU), sensors, mobile app, and voice assistant.

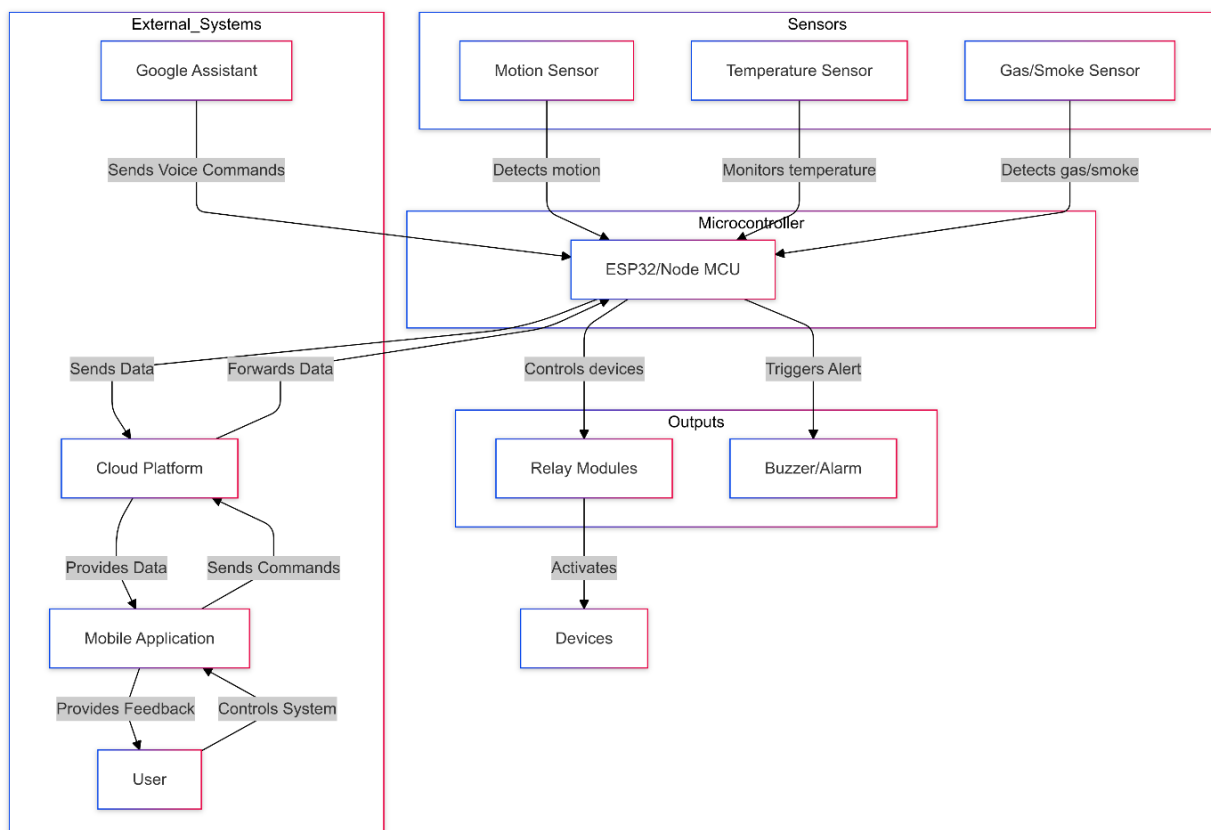


Figure 1: Home Automation System Architecture

## Circuit Diagram

The **circuit diagram**, shown in **Figure 2**, details the connections among hardware components, including sensors, relay modules, and alarms, to ensure system functionality.

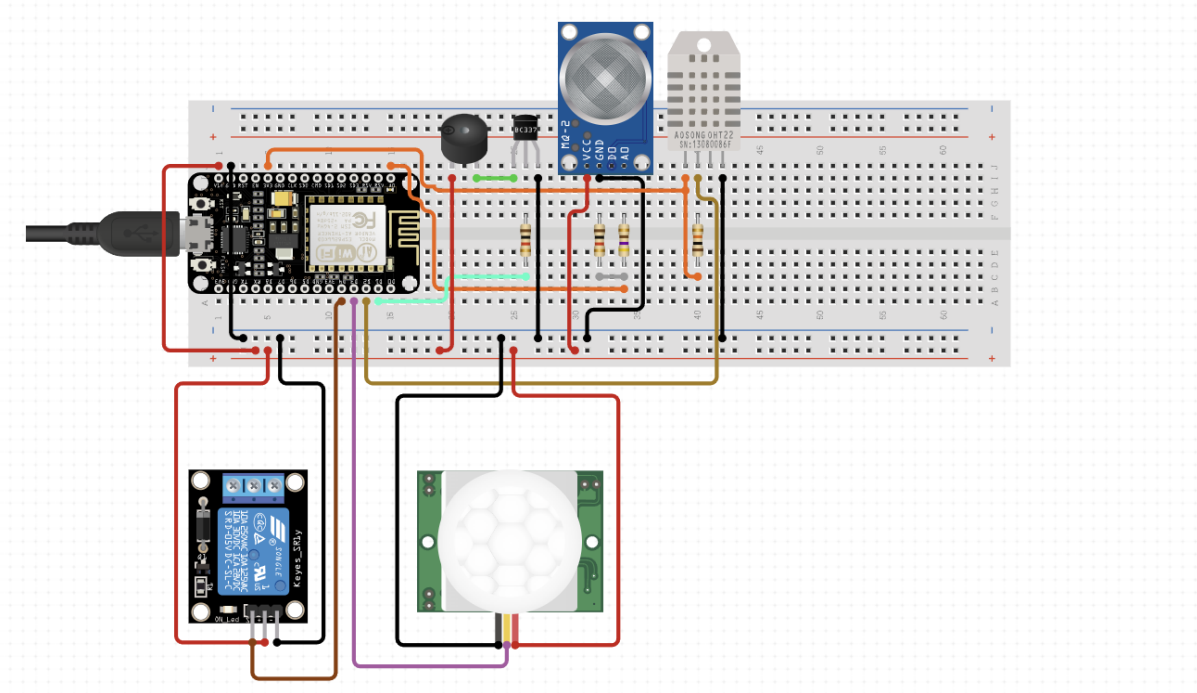


Figure 2: Circuit Diagram for Home Automation

## 3.2 Requirement Analysis

To successfully develop this home automation system, the following hardware and software will be needed:

### Hardware Requirements:

- **ESP32/Node MCU Microcontroller:** This will be the main controller, connecting the sensors to the mobile app and voice assistant.
- **Motion Sensor (PIR Sensor):** To detect movement and control lighting.
- **Gas Sensor (MQ-2 or MQ-5):** For detecting smoke or gas leaks.
- **Temperature Sensor (DHT11 or DHT22):** To monitor room temperature.
- **Relay Modules:** To control devices such as lights or fans based on sensor data.
- **Buzzer/Alarm:** To alert the user when smoke or gas is detected.

## Software Requirements

- **Arduino Cloud:** To program the microcontroller and manage the connections with the sensors. It will also integrate the Google Home for hands-free control.
- **React Native:** For building the mobile app to control and monitor the home automation system remotely.
- **Visual Studio Code:** The primary development environment for writing code for Mobile application and backend.

#### 4 Individual Contribution Plan

To ensure efficient project execution, each team member has been assigned specific responsibilities based on their expertise. The following table outlines the key tasks for each team member:

Team Member	Role	Responsibilities
Sahil Dahal	Project Management & Mobile App Development	<ul style="list-style-type: none"> <li>- Overall Project Management</li> <li>- Final project report review</li> <li>- React Native mobile app development</li> </ul>
Bishwash Katuwal	Hardware Specialist	<ul style="list-style-type: none"> <li>- Hardware setup and configuration</li> <li>- Microcontroller configuration</li> <li>- Hardware component testing</li> </ul>
Aarohi Basnet	System Architect	<ul style="list-style-type: none"> <li>- System architecture design</li> <li>- Component selection</li> </ul>
Drabesh Acharya	Google Assistant and cloud setup	<ul style="list-style-type: none"> <li>- Voice assistant integration</li> <li>- Software component testing</li> </ul>
Anisha Karki	Quality Assurance & Documentation Specialist	<ul style="list-style-type: none"> <li>- Overall user acceptance testing</li> <li>- Document the final project report</li> </ul>

Table 1: Work Breakdown

## 5 Conclusion

This home automation implements IoT technology for the improvement of comfort, safety, and energy efficiency within the home. The integration of motion, gas, and temperature sensors allows the system to provide easy home control and monitoring through a mobile app and voice-controlled commands via Google Assistant. The proposed software framework includes React Native for the application and Arduino Cloud for voice control, making the system simple to use, while MQTT ensures real-time communication.

Through this project, we plan to explore how IoT can address everyday challenges such as energy savings, improving security, and increasing comfort in homes. This is a low-cost and viable system that seeks to provide one of the possible solutions for various classes of home automation. As smart home technology grows, projects like this can show how automation makes life easier and safer. This proposal serves as a starting point for further development and improvement in home automation.

## 6 References

Fortune Business Insights, 2024. *Smart Home Market Size, Share, Analysis, Growth & Forecast, 2026.* [Online]

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